

## **Unit 1: Introduction To Biology**

### **Short Questions**

**1. What is Science?**

**Text Book Page # 2 (RWP 2014)**

**Ans:** "Science is the study in which observations are made, experiments are done and logical conclusions are drawn in order to understand principles of nature."

**2. Why was the scientific information not classified into different branches?**

**Ans:** In ancient times, the scientific information was not classified into different branches, as it exists today. All the scientific information was included under one head i.e. 'science'.

**Reason:**

With the passage of time scientific information increased many folds and this enormous scientific knowledge was then classified into different branches like:

- Biology
- Physics
- Chemistry
- Mathematics

**3. What are the thoughts of Dr. Abdus Salam about science?**

**Ans:** According to Dr. Abdus Salam,  
"Scientific Knowledge is common heritage of mankind."

**4. Define Biology and write also its meaning and derivation.**

**(BWP 2015)**

**Ans:** The word "biology" has been derived from two Greek words.  
'*bios*' meaning 'life'  
'*logos*' meaning 'thought or reasoning'  
"The scientific study of life is called Biology."

**5. What is the benefit of the study of living things?**

**Ans:** To understand and appreciate nature, it is essential to study the structures, functions and related aspects of living organisms. The study of living organisms provides information and remedies to human problems regarding:

- Health
- Food
- Environment

**6. What is difference between Zoology and Botany?**

**(BWP2013, LHR 2013, 2015, DGK 2014)**

**Ans:** Zoology:

This division of biology deals with the study of animals.

**Botany:**

This division of biology deals with the study of plants.

7. How would you differentiate between Morphology and Anatomy?

Text Book Page # 3 (LIIR 2015, DGK 2015)

Ans:

MORPHOLOGY	ANATOMY
<ul style="list-style-type: none"><li>• Morphology deals with the study of form structures of living organism.</li><li>• It includes study of physical features such as <u>size, shape, color of biological structures</u></li></ul>	<ul style="list-style-type: none"><li>• Anatomy deals with study of internal structure of living organisms.</li><li>• It includes study of cellular and tissue composition of biological structures</li></ul>

8. Define Molecular biology.

(SGD 2014)

Ans: "Molecular biology deals with the study of the molecules of life."

It is also known as biochemistry.

Example:

- Water
- Proteins
- Carbohydrates
- Lipids
- Nucleic acids

9. Define Morphology.

(GRW 2012)

Ans: Definition:

"This branch deals with the study of form and structures of living organisms."

10. What is difference between genetics and inheritance?

Ans: The study of genes and their role in inheritance is called genetics whereas transmission of characters from one generation to another is called inheritance.

11. What is cell biology?

(GRW 2013)

Ans: "The study of the structures and functions of cells and cell organelles is called cell biology."

This branch also deals with the study of cell division.

12. Define embryology.

(GRW 2013)

Ans: Definition:

"It is the study of the development of an embryo to new individual."

13. What are fossils?

(GRW 2013, SGD 2014)

Ans: Fossils are the remains of extinct organism.

Examples:

Coal

**14. What are Parasites? Give examples. (IHR 2013, RWP 2015, FSD 2014)**

**Ans:** "The organisms that take food and shelter from living hosts and, in return, harm them are called parasites."

**Examples:**

- Viruses
- Pathogenic Bacteria
- Lices

**15. Define Biotechnology. (IHR 2013, 2014, 2015, 2016, SWL 2015)**

**Ans:** "It deals with the practical application of living organisms to make substances for the welfare of mankind".

**Example:**

Production of human insulin by bacteria

**16. What do you know about Pharmacology?**

**Ans:** "It is the study of drugs and their effects on the systems of human body".

**Example:**

Paracetamol used as pain-killer

**17. What are the Major Biological Issues today?**

**(RWP 2014, SWL 2014, GRW 2014, MTN 2015)**

**Ans:** The major biological issues of today are as follow:

- Human population growth
- Infectious diseases
- Addictive drugs
- Environmental pollution

**18. How would you define inter-disciplinary sciences? Text Book Page # 4**

**Ans:** Biology includes information on various aspects of living things but these information relate to the other branches of sciences as well. Each branch of science has relationships with all other branches. This forms the basis of interdisciplinary sciences.

**Example:**

The study of basic metabolism of photosynthesis and respiration involves the knowledge of chemistry.

**19. What is meant by biophysics? (GRW 2012, BWP 2015, SGD 2015)**

**Ans:** "It deals with the study of the principles of physics, which are applicable to biological phenomena."

**Example:**

There is a similarity between the working principles of lever in physics and limbs of animals in biology.

**20. Define Biochemistry. (IHR 2014, SGD 2015)**

**Ans:** "It deals with the study of the chemistry of different compounds and processes occurring in

living organisms.”

**Examples:**

The study of basic metabolism of photosynthesis and respiration involves the knowledge of chemistry.

**21. What is meant by Biogeography? (GRW 2015)**

**Ans:** “It deals with study of the occurrence and distribution of different species of living organisms in different geographical regions of the world.”

It applies the knowledge of the characteristics of particular geographical regions to determine the characteristics of living organisms found there.

**22. Define Bio-metry.**

**Ans:** “It deals with study of biological processes using mathematical techniques and tools.”

**Example:**

To analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

**23. Define Bio-economics.**

**Ans:** “It deals with the study of organisms from economical point of view.”

**Example:**

The cost value and profit value of the yield of wheat can be calculated through bioeconomics.

**24. Define Agriculture and discuss role of agriculturist.**

**Ans:** “This profession deals with the food crops and animals which are the source of food.”

**Scope of Agriculture:**

An agriculturist works for the betterment of crops like wheat, rice, corn etc and animals from which we get food.

**25. What do you know about Horticulture?**

**Text Book Page # 5 (LIIR 2013, SWL 2014, RWP 2015)**

**Ans:** “This profession includes the art of gardening.”

**Scope of Horticulture:**

A horticulturist works for the betterment of existing varieties and for the production of new varieties of ornamental plants and fruit plants.

**Adaptation of Profession:**

Biology students can adopt this profession after their higher secondary education.

**26. Name the professions that can be adopted after bachelor levels of zoology.**

**Ans:** Following professions can be adopted after bachelor levels of zoology,

- Fisheries
- Farming
- Forestry

**27. What is farming? Give examples of different farms.**

**Ans:** “It deals with the development and maintenance of different types of farms.”

**Examples:**

- In some farms, animal breeding technologies are used for the production of animals which are better protein and milk source.
- In poultry farms, chicken and eggs are produced.
- In fruit farms, different fruit yielding plants are grown.

**28. Name any four careers in biology.**

**Ans:** Following are the four careers in biology,

- Medicine
- Surgery
- Fisheries
- Farming

**29. Quote a verse from Holy Quran that hints at common origin of all living things.**

**Text Book Page # 6**

**Ans:** At many places in Holy Quran, Allah hints about the common origin and characteristics of living organisms.

**Verse:**

**"We made every living thing from water."**

(Sura: Ambia, Verse: 30)

**30. What are the contributions of Abdul Malik Asmai in field of science?**

**Text Book Page # 7 (LIIR 2012, SGD 2014)**

**Ans:** He is considered the first Muslim scientist who studied animals in detail.

**Famous Books:**

His famous writings include:

- "Al-Abil (camel)"
- "Al-Khail (horse)"
- "Al-Wahoosh (animal)"
- "Khalq al-ansan"

**31. Describe the services of Jabir Bin Hayan. Also give names of his two famous books.**

**(GRW 2013, MTN 2014, BWP 2014, MTN 2015, DGK 2015)**

**Ans:** He was born in Iran and practiced medicine in Iraq. He introduced experimental investigation in chemistry and also wrote a number of books on plants and animals.

**Famous books:**

His famous books are,

- Al-Nabatat
- Al-Haywan.

**32. Name the books written by following scientists.**

**(LHR 2012)**

- (a) Jabir-Bin-Hayan
- (b) Abdul Malik Asmai
- (c) Bu-Ali-Sina

**Ans: Jabir-Bin-Hayan:**

Al-Nabatat, Al-Haywan

**Abdul Malik Asmal:**

Al-Abil (camel), Al-Khail (horse), Al-Wahoosh (animal), Khalq al-ansan

**Bu-Ali-Sina**

Al-Qanun-Fi-Al-Tib

**33. What is role of Bu Ali Sina in Biology?(SGD 2015, FSD 2015, SGD 2014, LHR 2016)**

**Ans:** He is honoured as the founder of medicine and called as Avicenna in the west. He was a physician, philosopher, astronomer and poet.

**Famous Book:**

One of his books "Al-Qanun-fi al-Tib" is known as the canon of medicine in West.

**34. Define an atom and also tell its meaning.**

**Ans: Definition:**

"An atom is defined as simplest form of matter which cannot be further sub divided"

It is composed of three fundamental particles:

- Electrons
- Protons
- Neutrons

**Meaning**

'a' means not and 'tom' means cut

**35. Define bio-elements and enlist them.**

**Text Book Page # 8 (DGK 2014, SWL 2015, GRW 2015)**

**Ans:** "The elements that take part in making the body mass of a living organism are called bio-elements."

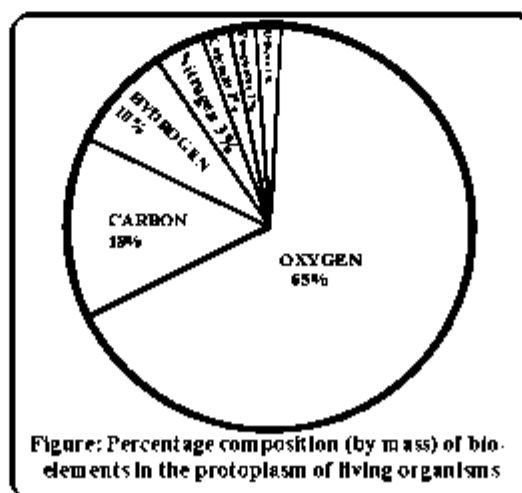
There are total 16 bio-elements

Only six (O, C, H, N, Ca, & P) make 99% of the total mass.

Other ten (K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn & I) collectively make 01 % of the total mass

**36. Draw a pie chart showing percentage composition of bioelements in protoplasm of living organisms?**

**Ans:**



**37. What is Biomolecule?**

**Ans:** "In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bonding. The stable particle formed by such bonding is called as biomolecule."

**Example:**

- Glucose
- Proteins

**38. Write down names of bio-molecules groups.**

**(LHR 2016)**

**Ans:** Following are the names of groups of bio-molecules.

- Micromolecules
- Macromolecules

**39. Differentiate between Micromolecule and Macromolecule. (RWP 2015, SGD 2015)**

**Ans:**

MICROMOLECULE	MACROMOLECULE
The biomolecules with low molecular weight are called micromolecules.	The biomolecules with high molecular weight are called macromolecules.
<b>Examples:</b> <ul style="list-style-type: none"><li>• Glucose</li><li>• Water</li></ul>	<b>Examples:</b> <ul style="list-style-type: none"><li>• Starch</li><li>• Proteins</li><li>• Lipids</li></ul>

**40. Explain macro molecules with example.**

**(SGD 2014, LIIR 2014)**

**Ans:** The bio-molecules which have high molecular weights are called macro molecules.

**Examples:**

- Starch
- Proteins
- Lipids

**41. What is the difference between organelle and cell?**

**Ans:**

ORGANELLE	CELL
Bio-molecules assemble in a particular way and form organelles.	The organelles are actually sub-cellular structures and when they assemble together, cells are formed.
<b>Examples:</b> <ul style="list-style-type: none"><li>• Mitochondria</li><li>• Ribosomes</li></ul>	<b>Examples:</b> <ul style="list-style-type: none"><li>• Animal Cell</li><li>• Plant Cell</li></ul>

**42. Define Tissue & Give examples.**

**Text Book Page # 9 (BWP 2015)**

**Ans:** "Similar cells performing similar functions are organized into groups called tissues"

**OR**

"A tissue is a group of similar cells specialized for the performance of a common function"

**Examples:**

- Epidermal tissue and ground tissue in plants
- Nervous tissue and muscular tissues in animals

**43. What is meant by organ system? (LHR 2014)**

**Ans:** Different organs performing related functions are organized together in the form of an organ system. In an organ system, each organ carries out its specific function and the functions of all organs appear as the function of the organ system.

**Example:**

The digestive system is an organ system that carries out the process of digestion. Major organs in its framework are oral cavity, stomach, small intestine, large intestine, liver, and pancreas. All these organs help in the process of digestion.

**44. What is the difference between organ system level of Animals and plants?**

**Text Book Page # 10**

**Ans:** The organ system level is less complex in plants as compared to animals.

**Reason:**

The less complexity of organ system level in plants is due to a greater range of functions and activities in animals than in plants.

**45. Define individual.**

**Ans:** "Different organs and organ systems are organized together to form an individual or organism."

**Coordination in Organism:**

In organism, the functions, processes and activities of various organs and organ systems are coordinated.

**46. Define Population. (MTN 2014, DGK 2015)**

**Ans:** "A group of organisms of the same species located at the same place in the same time is called population."

**Example:**

According to Ministry of Population Welfare, Government of Pakistan, human population in Pakistan in 2010 comprises of 173.5 million individuals.

**47. Define Community with its types. (GRW 2012, 2013, 2014)**

**Ans:** "An assemblage of different populations, interacting with one another within the same environment is called community."

**Example:**

A forest

**Types:**

Following are the types of community.

**(i) Complex Community:**

Some communities are complex.

**Examples:**

- A forest community
- A pond community



**(ii) Simple Community:**

Some communities may be simple.

**Example:**

A fallen log with various populations under it.

- In a simple community number and size of populations is limited.

**48. Name the levels of organization in correct order.**

**Ans:** Levels of organization:

- Sub atomic and atomic level
- Molecular level
- Organelle and cell level
- Tissue level
- Organ and organ system level
- Individual level
- Population level
- Community level
- Bio-sphere level

**49. What is biosphere level? (BWP2014, DGK 2014, SWL 2015, RWP 2015)**

**Ans:** "The part of the Earth inhabited by organism' communities is known as biosphere."

It constitutes all ecosystems (areas where living organisms interact with the nonliving components of the environment) and is also called the zone of life on Earth.

**50. Name the types of cellular organizations. Text Book Page # 11**

**Ans:** In living organisms the cells organize in three ways to make the bodies of organisms.

- Unicellular Organization
- Colonial Organization
- Multicellular Organization

**51. Name any four unicellular organisms. (GRW 2014, FSD 2015)**

**Ans:** The names of unicellular organisms are given below,

- Amoeba
- Paramecium
- Euglena
- Bacterium

**52. Describe colonial type of cellular organization with example?**

**Text Book Page # 12 (LHR 2013, GRW 2014)**

**Ans:** In colonial type of cellular organization, many unicellular organisms live together but do not have any division of labour among them.

Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements.

**Example:**

- *Volvox* is a green alga found in water that shows colonial organization. Hundreds of *Volvox* cells make a colony.

**53. What is multicellular organization? Explain with an example. (GRW 2013)**

**Ans:** In multicellular organization, cells are organized in the form of tissues, organs and organ systems.

**Examples:**

- Frog and mustard plants are the familiar examples of multicellular organization.

**Explanation:**

Frog shows the multicellular organization. The body is made of organ systems and each organ system consists of related organs. All the organs are made of specific tissues (epithelial, glandular, muscular, nervous etc).

**54. Write down scientific Names of Mustard Plant and Frog?**

(LHR 2012, SWL 2014, SGD 2014, BRW 2015)

**Ans:** Scientific name of mustard plant is,

*Brassica campestris*

Scientific name of Frog is,

*Rana tigrina*

**55. Write the importance of mustard plant.**

(DGK 2015, MTN 2015)

**Ans:** Mustard plant (scientific name: *Brassica campestris*) is sown in winter and it produces seeds at the end of winter. The plant body is used as vegetable and its seeds are used for extracting oil.

**56. What is difference between vegetative and reproductive organs of plants?**

(RWP 2015)

**Ans:**

VEGETATIVE ORGANS	REPRODUCTIVE ORGANS
The organs which do not take part in the sexual reproduction of the plant are called vegetative organs <b>Examples:</b> <ul style="list-style-type: none"><li>• Root</li><li>• Stem</li><li>• Branches</li><li>• Leaves</li></ul>	The organs which take part in the sexual reproduction of the plant and produce fruits and seeds are called reproductive organs  <b>Example:</b> <ul style="list-style-type: none"><li>• Flower</li></ul>

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## Unit 1: Introduction To Biology

### Multiple Choice Questions

- Science is the study that includes: Text Book Page # 2  
 (a) Observation (b) Experiments  
 (c) Both a and b (d) None of these
- Scientific study of living organisms is called: (DGK 2015, LHR 2016)  
 (a) Biotechnology (b) Chemistry  
 (c) Biology (d) Geology
- Word "Biology" has been derived from: (FSD 2014, RWP 2015)  
 (a) English (b) Greek  
 (c) Italian (d) French
- The word "Logos" means:  
 (a) Thought (b) Reasoning  
 (c) Both a and b (d) None of these
- The division of biology that deals with study of animals is called:  
 (a) Botany (b) Microbiology  
 (c) Anatomy (d) Zoology
- The branch of biology that deals with the study of form and structures of living organism is called: Text Book Page # 3  
 (a) Morphology (b) Anatomy  
 (c) Histology (d) Cell biology
- The microscopic study of tissues: (DGK 2014, MTN 2014, BWP 2015, LHR 2016)  
 (a) Paleontology (b) Pharmacology  
 (c) Entomology (d) Histology
- Histology is the scientific study of: (LHR 2015)  
 (a) Tissues (b) Muscles  
 (c) Cells (d) Organs
- The study of the functions of different parts of living organisms is called: (MTN 2015)  
 (a) Morphology (b) Anatomy  
 (c) Histology (d) Physiology
- The study of structure and functions of cells and cell organelles is:  
 (a) Histology (b) Anatomy  
 (c) Cell biology (d) Paleontology
- The study of internal structure is called: (RWP 2014, 2015, SWL 2014, GRW 2014)  
 (a) Morphology (b) Physiology  
 (c) Anatomy (d) Cell Biology
- The study of inheritance is called:  
 (a) Embryology (b) Genetics  
 (c) Zoology (d) Physiology
- The study of Genes and their roles in inheritance is called: (SGD 2014)  
 (a) Histology (b) Anatomy  
 (c) Genetics (d) Inheritance
- The study of remains of extinct organisms:  
 (a) Taxonomy (b) Palaeontology

- (c) Biotechnology (d) Entomology
15. The study of fossil is called: (SGD 2015, GRW 2015, LHR 2014, BWP 2014)  
 (a) Immunology (b) Pharmacology  
 (c) Palaeontology (d) Parasitology
16. Molecular biology is also known as:  
 (a) Biometry (b) Bioeconomics  
 (c) Biochemistry (d) None of these
17. The branch of biology that deals with the study of social behaviour of the animals that make societies:  
 (a) Socio Biology (b) Parasitology  
 (c) Entomology (d) Immunology
18. Study of insects is called: (MTN 2015, SWL 2015, LHR 2012)  
 (a) Immunology (b) Embryology  
 (c) Histology (d) Entomology
19. Study of occurrence and distributions of living organisms in different regions of world: Text Book Page # 4  
 (a) Biochemistry (b) Biogeography  
 (c) Biometry (d) Entomology
20. The cost and profit value of yield of wheat crop can be calculated through:  
 (a) Biogeography (b) Bioeconomics  
 (c) Biophysics (d) Biometry
21. The art of gardening: Text Book Page # 5 (SWL 2014)  
 (a) Agriculture (b) Forestry  
 (c) Horticulture (d) Animal Husbandry
22. Profession dealing with production of useful products through micro-organisms: (GRW 2013)  
 (a) Micro-Biology (b) Animal Husbandry  
 (c) Biotechnology (d) Biochemistry
23. "He made man from clay like the potter". The verse is taken from: Text Book Page # 6  
 (a) Sura Ambia (b) Sura Rehman  
 (c) Sura Al-Mominoon (d) Sura Al-Nur
24. The Surah of Quran which verifies classification is: Text Book Page # 7 (GRW 2014)  
 (a) Baqra (b) Al-Noor  
 (c) Quresh (d) Yasin
25. Date of birth of Jaber-Bin-Hayan: (LHR 2014)  
 (a) 740 AD (b) 980 AD  
 (c) 721 AD (d) 815 AD
26. Book written by Bu-Ali-Sina: (SGD 2015)  
 (a) Al-Nabatat (b) Al-Wahoosh  
 (c) Al-Qanun-fi al-Tib (d) None of these
27. By what name Bu Ali Sina is famous in Europe?  
 (a) Botanist (b) Poet  
 (c) Avicenna (d) Philosopher
28. The name of writer of "Al-Qanun-fi al-Tib" is: (GRW 2015, BWP 2015)  
 (a) Bu-Ali Sina (b) Al-Jahiz  
 (c) Abu Usman (d) Aristotle
29. Al-Nabatat and Al-Haywan are written by:  
 (a) Bu-Ali-Sina (b) Abdul Malik Asmai  
 (c) Jaber-Bin-Hayan (d) Al-Khwarizmi
30. Date of death of Bu-Ali-Sina:

- (a) 815 AD (b) 828 AD  
(c) 740 AD (d) 1037 AD
31. The famous book "Al-Abil" is written by: (LHR 2014)  
(a) Jabir bi Hayan (b) Abdul Malik Asmai  
(c) Darwin (d) Bu Ali Sina
32. The founder of medicine is: (SGD 2014, LHR 2016)  
(a) Jabir bin Hayan (b) Abdul Malik  
(c) Bu Ali Sina (d) Al-Beruni
33. Birth place of Jabir-Bin-Hayan: (RWP 2015, FSD 2014, LIIR 2016)  
(a) Iran (b) Iraq  
(c) Nepal (d) Syria
34. Total number of elements that occur in Nature: Text Book Page # 8  
(SGD 2014, DGK 2014, 2015)  
(a) 90 (b) 92  
(c) 80 (d) 88
35. Elements that take part in making body mass of a living organisms:  
(a) 15 (b) 18  
(c) 16 (d) 17
36. Percentage composition of water in protoplasm of all living things:  
(a) 50-60% (b) 60-70%  
(c) 70-80% (d) 80-90%
37. The element mostly present in an individual is:  
(a) Nitrogen (b) Carbon  
(c) Oxygen (d) Hydrogen
38. Percentage composition of oxygen in the protoplasm of living organisms:  
(a) 31% (b) 65%  
(c) 77% (d) 43%
39. Percentage composition of hydrogen in the protoplasm of living organisms:  
(a) 10% (b) 20%  
(c) 30% (d) 40%
40. Protons and Neutrons are included in \_\_\_\_\_ level,  
(a) Atomic (b) Molecular  
(c) Organelle (d) Sub-Atomic
41. Which one of the following is Macromolecule? (SGD 2015, SWL 2015)  
(a) Glucose (b) Water  
(c) Hydrogen (d) Starch
42. Which of the following is a micromolecule?  
(a) Starch (b) Protein  
(c) Lipid (d) Glucose
43. In how many groups biomolecules are divided? (DGK 2015)  
(a) Two (b) Three  
(c) Four (d) Five
44. Bio-molecules assemble in a particular way and form: Text Book Page # 9  
(a) Cell (b) Organ  
(c) Tissue (d) Organelle
45. Which level of organization is not visible in plants? (RWP 2015)  
(a) Individual Level (b) Organ system level  
(c) Organ (d) Tissue
46. An example of plant tissue:  
(a) Ground tissue (b) Muscular tissue  
(c) Nervous tissue (d) Connective tissue

47. Similar cells organized into groups and performing same function are known as: (MTN 2015, LIIR 2012)
- (a) Organelle (b) Tissue  
(c) Organ system (d) Organ
48. Stomach consists of:
- (a) Epithelial Tissue (b) Muscular tissue  
(c) Both (a) and (b) (d) Connective tissue
49. Members of the same species living in same place are called: (SWL 2014, GRW 2014, LIIR 2015)
- (a) Habitat (b) Biosphere  
(c) Community (d) Population
50. Human population in Pakistan in 2010 comprised of: Text Book Page # 10
- (a) 163.5 Million (b) 173.5 Million  
(c) 183.5 Million (d) 178.5 Million
51. The area of the environment in which organism lives:
- (a) Ecosystem (b) Habitat  
(c) Both a and b (d) Biosphere
52. Which one is not a complex community?
- (a) Forest (b) Pond  
(c) A fallen log (d) Habitat
53. Zone of life on earth:
- (a) Community (b) Ecosystem  
(c) Biosphere (d) None of these
54. Number of major groups in which all the organisms have been divided:
- (a) 2 (b) 3  
(c) 4 (d) 5
55. What is true About Amoeba? Text Book Page # 11
- (a) Unicellular Prokaryote (b) Multi-cellular eukaryote  
(c) Unicellular Eukaryote (d) Simple Multi-cellular
56. Amoeba is: (LHR 2014)
- (a) Autotrophic (b) Heterotrophic  
(c) Both (a) and (b) (d) Ectoparasites
57. Which one organism has colonial mode of life? Text Book Page # 12 (BWP 2014)
- (a) *Amoeba* (b) *Paramecium*  
(c) *Volvox* (d) *Euglena*
58. What is true about volvox? (SWL 2014)
- (a) Unicellular eukaryote (b) Multicellular eukaryote  
(c) Unicellular prokaryote (d) Colonial eukaryote
59. The scientific name *Brassica campestris* is for the plant: (DGK 2015)
- (a) Mango (b) Mustard  
(c) Apple (d) Melon
60. Mustard plant is sown in: (BWP 2015)
- (a) Summer (b) Winter  
(c) Spring (d) Autumn
61. Organ of plant that takes part in sexual reproduction: (GRW 2015)
- (a) Stem (b) Root  
(c) Leaf (d) Flower
62. Types of tissues present in frog: Text Book Page # 13
- (a) Epithelial (b) Glandular  
(c) Muscular (d) All of these

**ANSWERS KEY**

1	c	11	c	21	c	31	b	41	d	51	b	61	d
2	c	12	b	22	c	32	c	42	d	52	c	62	d
3	b	13	c	23	b	33	a	43	a	53	c		
4	c	14	b	24	b	34	b	44	d	54	d		
5	d	15	c	25	c	35	c	45	b	55	c		
6	a	16	c	26	c	36	b	46	a	56	b		
7	d	17	a	27	c	37	c	47	b	57	c		
8	a	18	d	28	a	38	b	48	c	58	d		
9	d	19	b	29	c	39	a	49	d	59	b		
10	c	20	b	30	d	40	d	50	b	60	b		

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## **Unit 1: Introduction To Biology**

### **Long Questions**

**Q.1 Describe divisions of Biology. (SWL 2014, FSD 2015) Text Book Page # 2**

**Ans:** **DIVISIONS OF BIOLOGY**

There are three major divisions of biology which study the different aspects of the lives of these groups.

**Zoology:**

The division of biology that deals with the study of animals is called Zoology.

**Botany:**

The division of biology that deals with the study of plants is called Botany.

**Microbiology:**

The division of biology that deals with the study of microorganisms is called Microbiology.

**Example:**

- Bacteria
- Viruses

**Q.2 Describe different Branches of Biology.**

**(LHR 2014, 16 DGK 2015 BWP 2015, SGD 2014 RWP 2015) Text Book Page # 3**

**Ans:** **BRANCHES OF BIOLOGY**

In order to study all aspects of life, biology is divided in following branches.

**(i) Morphology:**

The branch of Biology that deals with the study of form and structures of living organisms is called Morphology.

**(ii) Anatomy:**

The branch of Biology that deals with the study of internal structure of living organisms is called anatomy.

**(iii) Histology:**

The branch of Biology that deals with microscopic study of tissues is called histology.

**(iv) Cell Biology:**

The branch of Biology that deals with the study of structures and functions of cells and cell organelles is called cell biology. This branch also deals with the study of cell division.

**(v) Physiology:**

The branch of Biology that deals with the study of the functions of different parts of living organisms is called physiology.

**(vi) Molecular Biology (Biochemistry):**

The branch of Biology that deals with the study of the molecules of life is called

molecular biology.

**Examples:**

- Water
- Proteins
- Carbohydrates
- Lipids
- Nucleic acids

**(vii) Genetics:**

The branch of Biology that deals with the study of genes and their role in inheritance is called genetics.

**Inheritance:**

The transmission of characters from one generation to the other is called inheritance.

**(viii) Embryology:**

The branch of Biology that deals with the study of development of an embryo to new individual is called embryology.

**(ix) Taxonomy:**

The branch of Biology that deals with the study of naming and classification of organisms into groups and subgroups is called taxonomy.

**(x) Palaeontology:**

The branch of Biology that deals with the study of fossils is called palaeontology.

**Fossils:**

Fossils are the remains of extinct organisms.

**(xi) Environmental Biology:**

It deals with the study of the interactions that exist between the organisms and their environment.

**(xii) Parasitology:**

The branch of Biology that deals with the study of parasites is called parasitology.

**Parasites:**

Parasites are the organisms that take food and shelter from living hosts and, in return, harm them.

**(xiii) Socio-biology:**

The branch of Biology that deals with the study of social behaviour of the animals that make societies.

**(xiv) Biotechnology:**

The branch of Biology that deals with the study of the practical application of living organisms to make substances for the welfare of mankind is called biotechnology.

**(xv) Immunology:**

The branch of Biology that deals with the study of the immune system of animals, which defends the body against invading microbes is called immunology.

**(xvi) Entomology:**

The branch of Biology that deals with the study of insects is called entomology.

**(xvii) Pharmacology:**

The branch of Biology that deals with the study of drugs and their effects on the systems of human body is called pharmacology.

**Q.3 Describe relationship of Biology to other sciences.**

(LHR 2014, DGK 2014 MTN 2015 SGD 2015) Text Book Page # 4

**Ans:** **INTERDISCIPLINARY SCIENCES**

The interrelationship among different branches of science cannot be denied. Biology includes information on various aspects of living things but these information relate to the other branches of science as well. Each branch of science has relationships with all other branches. This forms the basis of interdisciplinary sciences.

**Example:**

When studying the process of movement in animals, the biologists have to refer to the laws of motion in physics.

**(i) Biophysics:**

It deals with the study of the principles of physics, which are applicable to biological phenomena.

**Example:**

There is a similarity between the working principles of lever in physics and limbs of animals in biology.

**(ii) Biochemistry:**

It deals with the study of the chemistry of different compounds and processes occurring in living organisms.

**Example:**

The study of basic metabolism of photosynthesis and respiration involves the knowledge of chemistry.

**(iii) Biomathematics / Biometry:**

It deals with the study of biological processes using mathematical techniques and tools.

**Example:**

To analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

**(iv) Biogeography:**

It deals with the study of the occurrence and distribution of different species of living organisms in different geographical regions of the world.

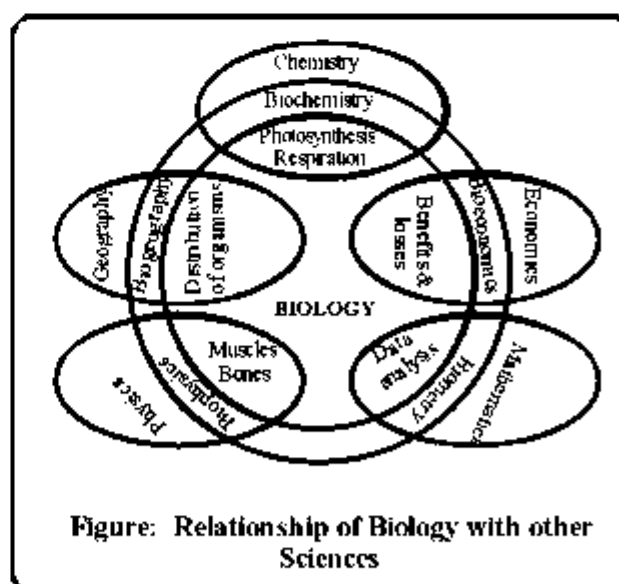
It applies the knowledge of the characteristics of particular geographical regions to determine the characteristics of living organisms found there.

**(v) Bioeconomics:**

It deals with the study of the organisms from economical point of view.

**Example:**

The cost value and profit value of the yield of wheat can be calculated through bioeconomics and benefits or losses can be determined.



**Figure: Relationship of Biology with other Sciences**

**Q.4 Write a note on careers in Biology.**

**Text Book Page # 5**

**(LHR 2015, MTN 2014, DGK 2014, RWP 2014)**

**Ans:**

**CAREERS IN BIOLOGY**

It is essential that students of today, who will occupy positions of leadership tomorrow, have the background of the modern and forward-looking branches of science.

**Advantage:**

An accurate and modern knowledge of biology, would promote a comprehension of both science and scientific research projects, which would benefit the learners in diverse list of careers. The following are the careers that a student of biology can plan to adopt.

**(i) Medicine / Surgery:**

The profession of medicine deals with the diagnosis and treatment of diseases in human. In surgery, the parts of the body may be repaired, replaced or removed.

**Example:**

The removal of stones through renal surgery, transplantation of kidney, liver etc.

**Professional courses:**

Both these professions are studied in the same basic course (MBBS) and then students go for specializations.

**(ii) Fisheries:**

Fisheries is the professional study of fish production.

**Departments in Pakistan:**

There are departments in Pakistan where professionals of fisheries are employed. They serve for enhancing the quality and quantity of fish production.

**Adoptation of Profession:**

In Pakistan, this profession can be adopted after the bachelor or masters level study of zoology and fisheries.

**(iii) Agriculture:**

This profession deals with the food crops and animals which are the source of food.

**Scope of Agriculture:**

An agriculturist works for the betterment of crops like wheat, rice, corn etc and animals, like buffalo, cow etc. from which we get food.

**Professional Courses:**

In Pakistan, there are many universities which offer professional courses on agriculture after the higher secondary education in biology.

**(iv) Animal Husbandry:**

It is the branch of agriculture concerned with the care and breeding of domestic animals (livestock) e.g. cattle, sheep etc.

**Professional courses:**

Professional courses in animal husbandry can be adopted after the higher secondary education in biology.

**(v) Horticulture:**

This profession includes the art of gardening.

**Scope of Horticulture:**

A horticulturist works for the betterment of existing varieties and for the production of

new varieties of ornamental plants and fruit plants.

Biology students can adopt this profession after their higher secondary education.

**(vi) Farming:**

It deals with the development and maintenance of different types of farms.

**Examples:**

- In some farms, animal breeding technologies are used for the production of animals which are better protein and milk source.
- In poultry farms, chicken and eggs are produced.
- In fruit farms, different fruit yielding plants are grown.

**Adoption of Profession:**

A student who has gone through the professional course of agriculture, animal husbandry or fisheries etc can adopt this profession.

**(vii) Forestry:**

In forestry, professionals look after natural forests and advises to the government for planting and growing artificial forests.

**Professional courses:**

Many universities offer professional courses in forestry after the higher secondary education in biology or after bachelor level study of zoology and botany.

**(viii) Biotechnology:**

It is the latest profession in the field of biology. Biotechnologists study and work for the production of useful products through microorganisms.

**Professional courses:**

Many universities offer courses in biotechnology after the higher secondary education in biology and after the bachelor level study of botany and zoology.

**Q.5 Write Quranic Verses and their translation about the origin and characteristics of living organisms.** Text Book Page # 6

**Ans:**

**QURAN AND BIOLOGY**

At many places in Holy Quran, Allah hints about the origin and characteristics of living organisms. In the same verses human beings have been instructed to expose the unknown aspects of life, after getting the hints. Here are few examples of such guidelines.

**Verse:**

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ . —

**Translation:**

**"We made every living thing from water."**

(Sura: Ambia, Verse: 30)

**Verse:**

خَلَقَ الْإِنْسَانَ مِنْ صَلْصَالٍ كَالْفَخَّارِ

**Translation:**

**"He made man from clay like the potter."**

(Sura: Rehman, Verse: 14)

Verse:

مِمَّ خَلَقْنَا السُّطُفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظًا فَكَسَوْنَا الْعِظَ لَحْمًا -

Translation:

"Then fashioned We the drop a clot, then fashioned, We the clot a little lump, then fashioned We the little lump bones, then clotted the bones with flesh."

(Sura: Al-Mominoon, Verse: 14)

Verse:

وَاللَّهُ خَلَقَ كُلَّ دَابَّةٍ مِنْ مَّاءٍ فَمِنْهُمْ مَنْ يَمْشِي عَلَى بَطْنِهِ " وَمِنْهُمْ مَنْ يَمْشِي عَلَى رِجْلَيْنِ " وَمِنْهُمْ مَنْ يَمْشِي عَلَى أَرْبَعٍ , يَخْلُقُ اللَّهُ مَا يَشَاءُ , إِنَّ اللَّهَ عَلَى كُلِّ شَيْءٍ قَدِيرٌ -

Translation:

"Allah hath created every animal from water. Then some of them creep up over their bellies, others walk on two legs, and others on four. Allah creates what He pleases."

(Sura: Al-Nur, Verse: 45)

Conclusion:

Quran hints not only at the origin and development of life but also at many characteristics of living organisms. Scientists reveal such mechanisms.

**Q.6 Describe contribution of Muslim scientists in the field of Biology.**

(GRW 2015, LIHR 2016, SWL 2014 SGD 2014) Text Book Page #7

Ans:

**MUSLIM SCIENTISTS**

Muslim scientists have made great contributions to the study of science and we are aware of their success in different fields of science. The work of Jabir Bin Hayan, Abdul Malik Asmai and Bu Ali Sina in the development of the present day knowledge of plants and animals is as follow.

**JABIR BIN HAYAN****Period:**

He was born in 721 AD and died in 815AD.

**Birth Place:**

He was born in Iran.

**Practice:**

He practiced medicine in Iraq.

**Contribution:**

He introduced experimental research in chemistry

**Famous Books:**

He also wrote a number of books on plants and animals. His famous books are

- "Al-Nabatat"
- "Al-Haywan".



### ABDUL MALIK ASMAI

**Period:**

He was born in 740 AD and died in 828AD.

**Contribution:**

He is considered the first Muslim scientist who studied animals in detail.

**Famous Books:**

His famous writings include:

- "Al-Abil (camel)"
- "Al-Khail (horse)"
- "Al-Wahoosh (animal)"
- "Kalq al-ansan"

### BU ALI SINA

**Period:**

He was born in 980 AD and died in 1037AD.

**Founder of Medicine:**

He is honoured as the founder of medicine and called as Avicenna in the West.

**Specializations:**

He was a physician, philosopher, astronomer and poet.

**Famous Book:**

One of his books "Al-Qanun-fi al-Tib" is known as the canon of medicine in West.



Photograph of Bu  
Ali Sina  
Commemorated on  
a ticket in Poland

**Q.7** Write a note on subatomic and atomic level.

**Ans:** SUBATOMIC AND ATOMIC LEVEL

**Elements:**

All types of matter are made up of elements.

**Atom:**

Each element contains a single kind of atoms.

**Meaning of Atom:**

The word atom means: ('a': not, 'tom': cut)

**Subatomic Particles:**

These atoms are actually made up of many subatomic particles.

The most stable subatomic particles are:

- Electrons
- Protons
- Neutrons

**Bioelements:**

The elements which take part in the formation of body mass of living organisms are called bioelements

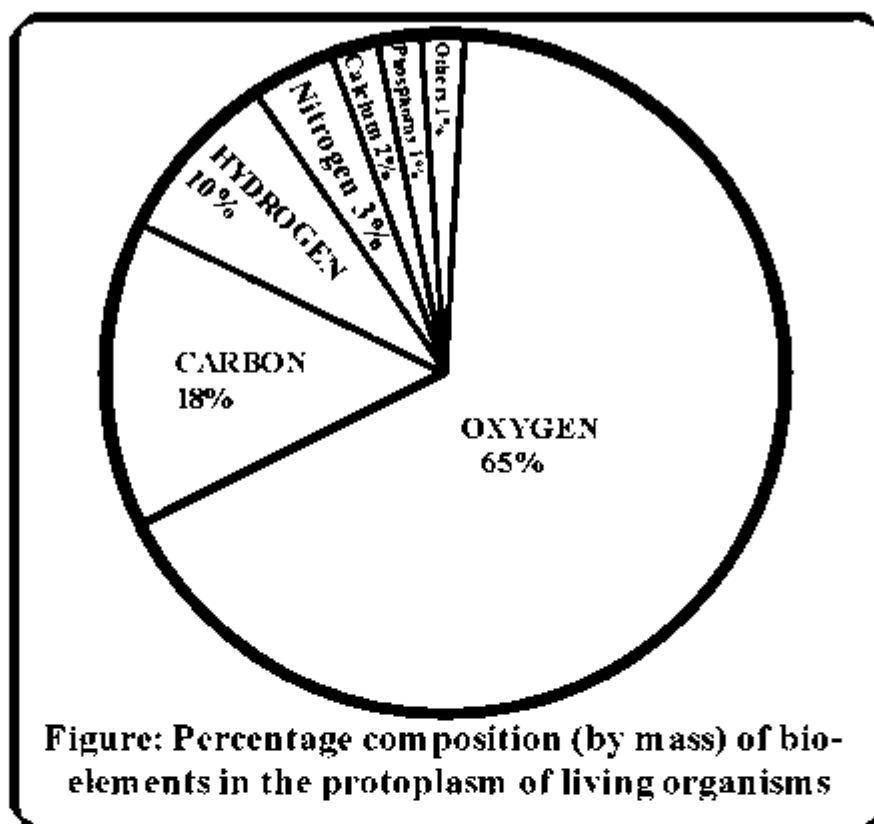
**Number:**

Out of the 92 kinds of elements that occur in nature, 16 are called bioelements.



Out of these bioelements;

- Only six (O, C, H, N, Ca, & P) make 99% of the total mass.
- Other ten (K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn, & I) collectively make 01% of the total mass.



**Q.8** Write a note on molecular level.

Text Book Page # 8

Ans:

### MOLECULAR LEVEL

#### **Molecule:**

The smallest part of a compound that retains the properties of that compound is called a molecule.

#### **Biomolecule:**

In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bonding. The stable particle formed by such bonding is called as biomolecule.

#### **Building Materials:**

An organism is formed by enormous number of biomolecules of hundreds of different types. These molecules are the building material and are themselves constructed in great variety and complexity due to specific bonding arrangements.

#### **Types of Biomolecules:**

Biomolecules are classified as micromolecules and macromolecules.

**Micromolecules:**

Micromolecules are with low molecular weight.

**Examples:**

- Glucose
- Water

**Macromolecules:**

Macromolecules are with high molecular weights.

**Examples:**

- Starch
- Proteins
- Lipids

**Q.9** Write a note on organelle and cell level.

(GRW 2014, FSD 2014 ) Text Book Page # 9

**Ans:**

**ORGANELLE AND CELL LEVEL**

**Organelles:**

Biomolecules assemble in a particular way and form organelles.

**Cell:**

The organelles are actually sub-cellular structures and when they assemble together units of life i.e cells are formed.

**Division of Labour:**

Each type of organelle is specialized to perform a specific function.

**Examples:**

- Mitochondria are specialized for cellular respiration
- Ribosomes are specialized for protein synthesis.

Functions of the cell are accomplished by these specialized structures. It is an example of the division of labour within the cell.

**Prokaryotes and Protists:**

In the case of prokaryotes and most protists, the entire organism consists of a single cell.

**Eukaryotes:**

In the case of most fungi, all animals and all plants, the organism consists of up to trillions of cells.

**Q.10** Write a note on tissue level.

(BWP 2014)

**Ans:**

**TISSUE**

“ In multicellular organisms, similar cells performing similar functions are organized into groups called tissues”

**OR**

“A tissue is a group of similar cells specialized for the performance of a common function”

**Function:**

Each cell in a tissue carries on its own life processes, like:

- Cellular respiration
- Protein synthesis

It also carries on some special processes related to the function of the tissue.

**Examples:**

- Epidermal tissue and ground tissue in plants
- Nervous tissue and muscular tissues in animals

**Q.11 Write a note on organ and organ system level. (BWP 2015, SGD 2015)**

**Ans:** **ORGAN LEVEL**

**Organ:**

In higher multicellular organisms, particularly in animals, more than one type of tissues having related functions are organized together and make a unit, called organ.

**Function:**

Different tissues of an organ perform their specific functions and these functions collectively become the function/s of that organ.

**Example:**

Stomach is an organ specialized for the digestion of proteins and for storing food.

**Types of Tissue:**

Two major types of tissues are present in its structure.

**(i) Epithelial (Glandular) Tissue:**

Secretes the gastric juice for the digestion of proteins

**(ii) Muscular Tissue:**

- Performs contractions of stomach walls for grinding of food
- Moving food to posterior end.

So, two tissues perform their specific functions, which collectively become the function of stomach.

### **ORGAN SYSTEM LEVEL**

**Definition:**

Different organs performing related functions are organized together in the form of an organ system.

**Function:**

In an organ system, each organ carries out its specific function and the functions of all organs appear as one process of the organ system.

**Example:**

Digestive system is an organ system that carries out the process of digestion.

**Major Organs:**

Major organs in its framework are oral cavity, stomach, small intestine, large intestine, liver and pancreas. All these organs help in the process of digestion.

**Organ System in Plants:**

The organ system level is less complex in plants as compared to animals.

The less complexity of organ system level in plants is due to a greater range of functions

and activities in animals than in plants.

**Q.12 Write a note on following.**

**Text Book Page # 10**

**(a) Individual Level**

**(b) Population Level**

**(c) Community Level**

**(d) Biosphere Level**

**Ans:**

**INDIVIDUAL LEVEL**

**Definition:**

Different organs and organ systems are organized together to form an individual or organism.

**Coordination in Organism:**

In organism, the functions, processes and activities of various organs and organ systems are coordinated.

**Example:**

When a man is engaged in continuous and hard exercise, not only his muscles are working but also there is an increase in the rate of respiration and heart beat. This accelerated rate of respiration and heart beat supplies more oxygen and food to the muscles which they need for continuous work.

**POPULATION LEVEL**

Biologists extend their studies to the population level where they study interactions among members of the same species living in the same habitat.

**Definition:**

A group of organisms of the same species located at the same place, in the same time is called population.

**Example:**

According to Ministry of Population Welfare, Government of Pakistan, human population in Pakistan in 2010 comprises of 173.5 million individuals.

**COMMUNITY LEVEL**

**(LHR 2013)**

**Definition:**

An assemblage of different populations, interacting with one another within the same environment is called community. Example:

A forest may be considered as a community. It includes different plants, microorganisms, fungi and animal species.

**Change in Population:**

Communities are collections of organisms, in which one population may increase and others may decrease.

Any change in biotic or abiotic factors may have drastic and long lasting effects.

Following are the types of community

**(i) Complex Community:**

Some communities are complex

**Examples:**

A forest community, a pond community

**(ii) Simple Community:**

Some communities may be simple

**Example:**

A fallen log with various populations under it

In a simple community number and size of populations is limited.

### BIOSPHERE LEVEL

**Definition:**

The part of the earth inhabited by organisms' communities is known as biosphere.

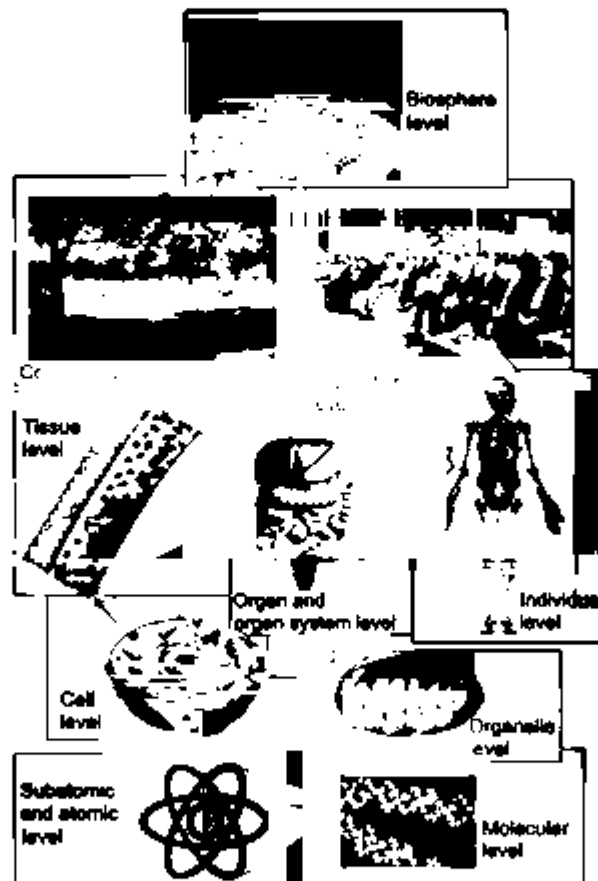
It constitutes all ecosystems.

**Zone of Life:**

Biosphere is called Zone of life on Earth.

**Ecosystem:**

The area where the living organisms interact with the non-living components of environment is called as Ecosystem.



**Figure: Levels of Organization**

**Q.13** Write a note on cellular organizations.

**Ans:** **CELLULAR ORGANIZATIONS**

**Major Groups of Organisms:**

All organisms have been divided into five major groups:

- Prokaryotes
- Protists
- Fungi
- Plants
- Animals

**Types of Cells:**

All organisms are made up of cells. There are two basic types of cells i.e.

- Prokaryotic
- Eukaryotic

The organisms in first group are made up of prokaryotic cells while all other groups have eukaryotic cells.

**Types of Cellular Organization:**

In living organisms the cells organize in three ways to make the bodies of organisms.

- (i) Unicellular Organization
  - (ii) Colonial Organization
  - (iii) Multicellular Organization
- (i) **Unicellular Organization:**

The organisms formed through unicellular organization are called as unicellular organisms. In unicellular organisms, only one cell makes the life of an organism. All the life activities are carried out by the only cell.

**Examples:**

- Amoeba
- Paramecium
- Euglena



Figure: *Amoeba*

*Paramecium*

*Euglena*

- (ii) **Colonial Organization:**

In colonial type of cellular organization many unicellular organisms live together but do

not have any division of labour among them.

Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements.

**Example:**

*Volvox* is a green alga found in water that shows colonial organization. Hundreds of *Volvox* cells make a colony



Figure: *Volvox* colony

**(iii) Multicellular Organization:**

In multicellular organization cells are organized in the form of tissues, organs and organ systems.

**Examples:**

- Mustard plant
- Frog

**MUSTARD PLANT**

**Scientific Name:**

***Brassica campestris***

**Cultivation Time:**

Mustard plant is sown in winter and it produces seeds at the end of winter.

**Uses:**

- The plant body is used as vegetable
- Its seeds are used for extracting oil.

**Types of Organs:**

The organs of the body can be divided into two groups on the basis of their functions.

**Vegetative Organs:**

The organs which do not take part in the sexual reproduction of the plant are called vegetative organs.

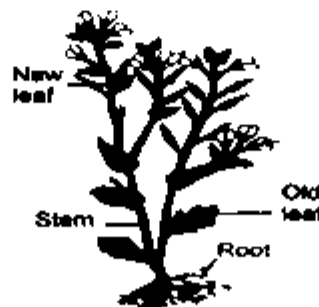


Figure: Mustard Plant

**Examples:**

- Root

- Stem
- Branches
- Leaves

**Reproductive Organs:**

The organs which take part in sexual reproduction and produce fruits and seeds are called reproductive organs.

**Example:**

Flowers

**FROG**

**Scientific Name:**

***Rana tigrina***

Frog shows the multicellular organization.

**Organ Systems:**

The body is made of organ systems and each organ system consists of related organs. All the organs are made of specific tissues:

- Epithelial
- Glandular
- Muscular
- Nervous



Figure: Frog

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## Unit 2: Solving a Biological Problem

### Short Questions

1. Do you think that “Man has always been a biologist”? If so why? Text Book Page # 20

**Ans:** A man has always been a biologist. He had to be a biologist in order to live. Early in history, he was hunter of animals and a gatherer of fruits, seeds, roots etc. The more he knew about animals and their habitat, the more successful hunter he was. The more he knew about plants, the better he distinguished between edible and non-edible plants.

2. Define Biological Method. (GRW 2013, DGK 2015, BWP 2015)

**Ans:** “The scientific method, in which biological problems are solved, is termed as Biological Method.”

- It comprises the steps a biologist adopts in order to solve a biological problem.
- 

3. How biological method has played an important part in scientific research?

**Ans:** The biological method has played an instrumental role in scientific research for almost 500 years.

- From Galileo’s experiment back in the 1590’s to current research, the biological method has contributed to advancements in medicine, ecology, technology, etc.
- The biological method ensures the quality of data for public use.
- 

4. Write steps of Biological Method in a sequence. Text Book Page # 21

**Ans:** Biological method involves the following main steps:

- Recognition of a biological problem
- Observations
- Hypothesis formulation
- Deductions
- Experimentation
- Summarization of results (tables, graphics etc.)
- Reporting the results
- 

5. Define Biological Problem. (FSD 2014, SGD 2014)

**Ans:** “A question related to living organisms that is either asked by some one or comes in biologist’s mind by himself is called biological problem”.

**Example:**

Malaria

6. What is the difference between qualitative and quantitative observations?  
(GRW 2012, LHR 2013, SWL 2014, MTN 2015, BWP 2015)

Ans:

QUALITATIVE OBSERVATIONS	QUANTITATIVE OBSERVATIONS
<ul style="list-style-type: none"><li>Qualitative observations are considered less accurate</li><li>These observations are variable and less measurable.</li><li>These can not be recorded in terms of numbers.</li></ul> <p>Examples:</p> <ul style="list-style-type: none"><li>The freezing point of water is colder than its Boiling Point.</li><li>A liter of water is heavier than a liter of ethanol.</li></ul>	<ul style="list-style-type: none"><li>Quantitative observations are considered more accurate</li><li>These observations are invariable and measurable.</li><li>These can be recorded in terms of numbers.</li></ul> <p>Examples:</p> <ul style="list-style-type: none"><li>The freezing point of water is 0°C and the boiling point is 100°C.</li><li>A liter of water weighs 1000 grams and a Liter of ethanol weighs 789 grams.</li></ul>

7. Why quantitative observations are better in biological method?  
(DGK 2014, GRW 2014, RWP 2014, LHR 2015)

Ans: Quantitative observations are better because these are invariable and measureable and can be recorded in terms of numbers.

Example:

The freezing point of water is 0°C and the boiling point is 100°C.

8. How did Darwin formulate the theory of evolution?

Ans: Darwin not only observed and took notes during his voyage, but he also read the works of other naturalists to form his theory of Evolution.

9. Define hypothesis? Text Book Page # 22 (BWP 2015)

Ans: "A tentative explanation of the observations is called hypothesis."

OR

"A proposition that might be true is called hypothesis."

Example:

Plasmodium is the cause of malaria

10. How hypothesis is framed?

Ans: A great deal of careful and creative thinking is necessary for the formulation of a hypothesis. Biologists use reasoning to formulate a hypothesis.

11. What are the characteristics of a good hypothesis?

(LHR 2012, 2015, 2016, RWP 2015)

Ans: A good hypothesis should have the following characteristics:

- It should be a general statement
- It should be a tentative idea.

- It should agree with available observations.
- It should be kept as simple as possible.
- It should be testable and potentially falsifiable. In other words, there should be a way to show that the hypothesis is false, a way to disprove the hypothesis.

**12. Define deductions. How deduction are formed?**

(LHR 2012, MTN 2015, SGD 2015)

**Ans:** "The logical consequences of a hypothesis are called deductions".

**Formulation:**

For this purpose, a hypothesis is taken as true and expected results are drawn from it.

Generally, in a biological method, if a particular hypothesis is true, then one should expect (deduction) a certain result. It involves the use of "if-then" logic.

**13. Develop a deduction from the following hypothesis.**

"All plant cells have a nucleus."

**Ans:** "If I examine cells from a blade of grass, then each one will have a nucleus."

**14. Why a biologist go for experimentation during solving a biological problem?**

**Ans:** A biologist performs experiments to see if hypothesis are true or not.

The deductions which are drawn from hypothesis are subjected to rigorous testing. Through experimentation, a biologist learns which hypothesis is correct.

**15. What is control in an experiment?**

**Text Book Page # 23**

(LHR 2013, 2014, DGGK 2014, FSD 2015, RWP 2015)

**Ans:** In science, when doing an experiment, it must be a controlled experiment. A scientist must contrast an 'experimental group' with a 'control group'.

The two groups are treated exactly alike except for the one variable being tested.

**Example:**

In an experiment to test the necessity for carbon dioxide during photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide) with an experimental group (a plant with no carbon dioxide available). The necessity of carbon dioxide will be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

**16. What are different ways of reporting results of biological method? (SWL 2015)**

**Ans:** Biologists publish their findings in scientific journals and books, in talks at national and international meetings and in seminars at colleges and universities.

**Importance:**

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

**17. How did physicians describe malaria in early days?**

**Ans:**

- The early physicians described malaria as a disease of chills and fevers with recurring attacks.
- They also observed that the disease was more common among people living in low, marshy areas.

**18. What was the possible cause of malaria in early days?**

**Ans:** It was thought in early days that stagnant water of marshes poisoned the air and as a result of breathing in this 'Bad Air', people got malaria.

**19. What does the word malaria mean?**

**(I.H.R 2014)**

**Ans:** The word malaria has been derived from two Italian words:

- 'Mala' means 'bad'
- 'Aria' means 'air'

**20. What was the treatment of malaria in early days?**

**Ans:** In the 17<sup>th</sup> century, when the New World (America) was discovered, many plants from America were sent back to Europe to be used as medicines. The bark of a tree known as 'quina-quina' was very suitable for curing fevers. It was so beneficial that it soon became impossible to carry enough bark to Europe. Some dishonest merchants began to substitute the bark of another tree, the 'cinchona' which closely resembled quina-quina.

This dishonesty proved much valuable for mankind. The cinchona bark was found to be excellent for treating malaria. The cinchona bark contains quinine which is effective in treating the disease. Quinine was the only effective remedy for malaria from 17<sup>th</sup>-20<sup>th</sup> century.

**21. Describe the contributions of Laveran in discovery of *Plasmodium*. (RWP 2014)**

**Ans: Contribution of Laveran**

In 1878, a French army physician Laveran began to search for the cause of malaria.

**Experiments:**

He took a small amount of blood from a malarial patient and examined it under a microscope. He noticed some tiny living creatures. His discovery was not believed by other scientists.

**Confirmation:**

- Two years later, another physician saw the same creatures in the blood of another malarial patient.
- Three years later after this second discovery, the same creatures were observed for the third time.

**Naming of Organism:**

The organism was named '*Plasmodium*'.

**22. What were observations for malaria until 19<sup>th</sup> century? (FSD 2015)**

**Ans:** In the last part of 19<sup>th</sup> century, many different causes of malaria were being suggested. By that time there were four major observations about malaria.

- Malaria and marshy areas have some relation.
- Quinine is an effective drug for treating malaria.
- Drinking water from marshes does not cause malaria.
- 'Plasmodium' is seen in the blood of malarial patients.

**23. What is incubation period? (SWL 2015)**

**Ans:** "The period between the entry of parasite in host and the appearance of symptoms is called incubation period."

**24. Design a deduction from following hypothesis.**

**"Plasmodium is cause of malaria"**

**Ans:** One of the deductions from the above hypothesis can be:

*'If Plasmodium is the cause of malaria, then all persons ill with malaria should have Plasmodium in their blood'.*

**25. Write down observations of A.F.A King about malaria.**

**Text Book Page # 25 (LHR 2014, MTN 2015)**

**Ans:** In 1883, a physician, A.F.A King, listed 20 observations:

Some of his important observations were:

- People who slept outdoors were more likely to get malaria than those who slept indoors.
- People who slept under fine nets were less likely to get malaria than those who did not use such nets.
- Individuals who slept near a smoky fire usually did not get malaria.

**26. What is required for the maturation of eggs of female mosquito?**

**Ans:** Female mosquitoes need blood of mammals or birds for the maturation of their eggs.

**27. Why Ronald Ross used sparrow in his experiment? (GRW 2014)**

**Ans:** Ronald Ross used sparrow in his experiment because scientists avoid using human beings for experiments when results could be so serious.

**28. How did Ross prove that mosquitoes transmit plasmodium and spread malaria?(GRW 2012)**

**Ans:** Ronald Ross, a British army physician working in India, in 1880's, performed important experiments.

**Experiment 1:**

- He allowed a female *Anopheles* mosquito to bite a malarial patient.
- He killed the mosquito some days later.
- On examining the mosquito, *Plasmodium* was found multiplying in mosquito's stomach.

**Experiment 2:**

- He allowed a female *Culex* mosquito to bite the sparrows suffering from malaria.
- Some of the mosquitoes were killed and studied at various times.
- Ross found that *Plasmodium* multiplied in the wall of mosquito's stomach and then moved into the mosquito's salivary glands.
- He kept some of the mosquitoes alive and allowed them to bite healthy sparrows.

**Results:**

Ross found that saliva of the infected mosquitoes contained *Plasmodia* and these entered sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

**29. Why does female mosquito injects small amount of saliva into the wound?****Text Book Page # 26**

**Ans:** When a female mosquito pierces the skin with her mouth parts, she injects a small amount of saliva into the wound before drawing blood. This saliva prevents the blood from clotting in her food canal.

**30. Why do welts appear after mosquito bite?****(LHR 2013)**

**Ans:** The welts that appear after the mosquito leaves is not a reaction to the wound, but an allergic reaction to the saliva. In most cases, the itching sensation and swellings subside within several hours.

**31. What is scientific law? Give two examples?****(LHR 2013, SWL 2014)**

**Ans:** "If a theory survives doubtful approach and continues to be supported by experimental evidence, it becomes a law or principle."

A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

**Examples:**

Hardy-Weinberg law and Mendel's laws of inheritance.

**32. What is difference between theory and law?****Text Book Page # 27 (SWL 2014, DGK 2014, LHR 2015, 2016)****Ans:**

Theory	Law
<ul style="list-style-type: none"> <li>• A hypothesis that stands the test of time (often tested and never rejected) is called theory.</li> <li>• A theory may be challenged.</li> <li>• A theory can be altered in case of new evidence.</li> <li>• A theory is always subjected to new testing</li> </ul> <p><b>Example:</b> Darwin's theory of evolution</p>	<ul style="list-style-type: none"> <li>• A scientific law is a uniform, constant fact of nature. It is irrefutable theory.</li> <li>• A law cannot be challenged.</li> <li>• A law is already an established and definite entity. It cannot be altered.</li> <li>• A law is not subjected to further testing.</li> </ul> <p><b>Example:</b> Hardy-Weinberg Law</p>

33. Define data.

Ans: "The information such as names, dates, or values made from observations and experimentation is called data."

34. In which formats data is organized?

Text Book Page # 28

Ans: Data is organized into different formats like:

- Graphics
- Tables
- Flow-charts
- Maps
- Diagrams

35. Define ratio.

(MTN 2015)

Ans: "When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient ( $a/b$ ) it is called the ratio of one number to the other."

Expression of a ratio:

A ratio is expressed by putting a division ( $\div$ ) or colon ( $:$ ) mark between two numbers.

Example:

The ratio between 50 malarial patients and 150 normal patients is 1:3.

36. In what major biological problems is the knowledge of Mathematics used?

Ans: Major biological problems, in which knowledge of mathematics is used include:

- Gene finding
- Protein structure
- Protein-protein interactions

37. Define Bioinformatics.

(SWL 2014, BWP 2014, LHR 2016)

Ans: "The use of the computational and statistical techniques for the analysis of biological data is called bioinformatics."

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## Unit 2: Solving A Biological Problem

### Multiple Choice Questions

1. Scientists that use scientific method to make new theories: Text Book Page # 20  
(a) Biologist (b) Chemists  
(c) Physicists (d) All of these
2. The scientific method in which biological problems are solved is called: (SGD 2014)  
(a) Geological problem (b) Biological method  
(c) Non-biological method (d) All of these
3. Era of Biological method in scientific research:  
(a) 700 years (b) 500 years  
(c) 600 years (d) 525 years
4. Biological method has been playing an important role for the last: (LHR 2013)  
(a) 400 years (b) 500 years  
(c) 600 years (d) 1000 years
5. Biological Method comprises of \_\_\_\_\_ steps: (MTN 2015)  
(a) 5 (b) 6  
(c) 7 (d) 8
6. Galileo performed his experiments in:  
(a) 1690's (b) 1790's  
(c) 1590's (d) 1650's
7. The problem related to living organisms:  
(a) Chemical (b) Geological  
(c) Biological (d) Physical
8. Quantitative observations are considered: Text Book Page # 21  
(a) Less accurate (b) Invariable  
(c) More accurate (d) Both b & c
9. The freezing point of water:  
(a) 10 °C (b) 0 °C  
(c) 5 °C (d) 15 °C
10. Weight of one kilogram of water: (GWL 2014)  
(a) 900 grams (b) 1000 grams  
(c) 800 grams (d) 700 grams
11. Weight of one kilogram of ethanol:  
(a) 879 grams (b) 789 grams  
(c) 987 grams (d) 768 grams
12. A proposition that might be true: Text Book Page # 22  
(a) Deduction (b) Theory  
(c) Law (d) Hypothesis
13. The tentative explanation of observation is called: (DGK 2014)  
(a) Hypothesis (b) Theory  
(c) Deductions (d) Result
14. Which one of the following is not the characteristic of a good hypothesis?(LIIR 2015)  
(a) Must be consistent with available data (b) Must be testable  
(c) Must be correct (d) Must have prediction
15. Logical consequence drawn from hypothesis:

- (RWP 2014, 2015, SGD 2015, DGK 2015, GWL 2013)
- (a) Observation (b) Deduction  
(c) Experimentation (d) Result
16. In biological method the next step of hypothesis is called: (LHR 2012)  
(a) Deduction (b) Observation  
(c) Result (d) Experiment
17. "If I examine cells from a blade of grass, then each one will have a nucleus". This statement is:  
(a) Theory (b) Hypothesis  
(c) Deduction (d) Law
18. \_\_\_\_\_ is most basic step of biological method: (MTN 2014)  
(a) Observations (b) Hypothesis  
(c) Experimentation (d) Deductions
19. Physicians were familiar with malaria \_\_\_\_\_ years ago : Text Book Page # 23  
(a) 2000 (b) 2500  
(c) 1500 (d) 2100
20. The word Malaria is derived from which language?  
(a) German (b) Italian  
(c) French (d) Greek
21. The word "mala" means:  
(a) Air (b) Bad  
(c) Poor (d) Both a & b
22. When was America discovered?  
(a) 16<sup>th</sup> century (b) 17<sup>th</sup> century  
(c) 18<sup>th</sup> century (d) 20<sup>th</sup> century
23. Which disease has killed more people than any other disease?  
(a) Cancer (b) AIDS  
(c) Tuberculosis (d) Malaria
24. Bark of Quina- Quina was used for treating:  
(a) Typhoid (b) Malaria  
(c) Tetanus (d) Fever
25. The bark of which tree was very suitable for curing malaria?(SWL 2015, LHR 2015)  
(a) Cedrus (b) Cinchona  
(c) Pinus (d) Cactus
26. Quinine is obtained from: Text Book Page # 24  
(a) Cinchona Bark (b) Quina Quina Bark  
(c) Both a & b (d) None of these
27. The bark of cinchona contains a chemical: (SWL 2015, GRW 2012)  
(a) Gum (b) Quinine  
(c) Glue (d) Honey
28. Quinine is an effective remedy for: (GRW 2013)  
(a) Diabetes (b) Malaria  
(c) Cholera (d) Diarrhoea
29. Most effective remedy against malaria upto 20<sup>th</sup> century: (BRW 2014)  
(a) Ranitidine (b) Quinine  
(c) Amoxicillin (d) All of these
30. French Army Physician who worked on malaria in 1878: (SGD 2015)  
(a) Laveran (b) Ronald Ross  
(c) A.F.A king (d) Mendel
31. Who started to know the reason of malaria? Text Book Page # 24 (GRW 2012)  
(a) Hackel (b) Laveran

- (c) Ronald Ross (d) Mendel
32. Laveran began to search for cause of malaria in:  
(a) 1978 (b) 1870  
(c) 1878 (d) 1880
33. Who discovered *Plasmodium*?  
(a) Laveran (b) A. F. A. King  
(c) Ronald Ross (d) Darwin
34. *Plasmodium* was discovered in:  
(a) 1876 (b) 1878  
(c) 1880 (d) 1882
35. Malaria is caused by: (FSD 2015, DGK 2015, SWL 2014, LHR 2014)  
(a) Plasmodium (b) Entamoeba  
(c) Paramecium (d) E-coil
36. "If Plasmodium is the cause of malaria, then all the person ill with malaria should have plasmodium in their blood". This statement is: (LHR 2013)  
(a) Hypothesis (b) Deduction  
(c) Theory (d) Law
37. Mark the incorrect observation about malaria:  
(a) Malaria is associated with marshes.  
(b) Quinine is an effective drug for treating malaria.  
(c) Drinking water of marshes causes malaria.  
(d) Individuals who slept near a smoky fire usually did not get malaria.
38. In which year, A. F. A. King listed his 20 observations: Text Book Page # 25  
(GRW 2014, LHR 2014, 2015)  
(a) 1881 (b) 1882  
(c) 1883 (d) 1884
39. How many observations were presented by A.F.A king? (GRW 2013)  
(a) 14 (b) 18  
(c) 20 (d) 22
40. Ronald Ross belonged to:  
(a) Germany (b) Great Britain  
(c) Holland (d) America
41. Ronald Ross performed experiments in: (BRW 2015)  
(a) 1878 (b) 1880  
(c) 1885 (d) 1883
42. "Mosquitoes transmit plasmodium and are involved in spread of malaria" who suggested this hypothesis? (LHR 2012)  
(a) Laveran (b) Aristotle  
(c) Redi (d) A.F.A. king
43. Female Mosquitoes used by Ross in his experiments:  
(a) Anopheles and Aedes (b) Aedes and culex  
(c) Culex and Anopheles (d) All of these
44. Female mosquitoes need the blood of \_\_\_ for the maturation of their eggs: (MTN 2015)  
(a) Mammals (b) Birds  
(c) Both (a) and (b) (d) Reptiles
45. Anopheles mosquito causes a disease: (DGK 2014)  
(a) Dengue fever (b) Malaria Fever  
(c) Typhoid Fever (d) Flu Fever
46. Malaria in sparrows spread by: (BRW 2015, GRW 2012, 2016, LIIR 2012, 2016)  
(a) Ordinary Mosquito (b) culex mosquito  
(c) Anopheles mosquito (d) Aedes mosquito

47. The malaria is spread in birds by: (RWP 2015)  
 (a) Anopheles (b) Dengue  
 (c) Aedes (d) Culex
48. Plasmodium is transferred by:  
 (a) Fly (b) Virus  
 (c) Mosquito (d) Bacteria
49. Who is responsible for spread of malaria fever? (SGD 2014, SWL 2014)  
 (a) Virus (b) Plasmodium  
 (c) Amoeba (d) Paramecium
50. Ross found mosquitoes multiplying in: (GRW 2013)  
 (a) Salivary glands (b) Blood  
 (c) Stomach (d) Both a & c
51. Mosquito that transmits dengue fever: Text Book Page # 26 (LHR 2016)  
 (a) Culex (b) Anopheles  
 (c) Aedes (d) Female anopheles mosquito
52. In dengue fever, which cells are shorten? (RWP 2014)  
 (a) R.B.C (b) Platelets  
 (c) W.B.C (d) All of these
53. Blood clotting in food canal of mosquito is prevented by.  
 (a) Lymph (b) Platelets  
 (c) Saliva (d) All of these
54. A Hypothesis that is often tested and never rejected is called: (GRW 2012, 2015)  
 (a) Law (b) Theory  
 (c) Principle (d) Deduction
55. The hypothesis that stands the test of time are called: (FSD 2014, LIIR 2012)  
 (a) Experiments (b) Deductions  
 (c) Theories (d) Observation
56. A theory is supported by a great deal of:  
 (a) Evidence (b) Result  
 (c) Experiment (d) Observation
57. An irrefutable theory: Text Book Page # 27  
 (a) Deduction (b) law  
 (c) Hypothesis (d) All of these
58. The information such as names, dates or values made from observations and experimentation:  
 (a) Data (b) Theory  
 (c) Law (d) Observation
59. A relation between two numbers in terms of quotient is called: Text Book Page # 28  
 (a) Proportion (b) Ratio  
 (c) Both a & b (d) None of these

60. Proportion is expressed by putting a sign:  
 (a) = (b) : :  
 (c) both a & b (d) :
61. Summarizing data through the calculation of a mean value:  
 (a) Mathematics (b) Statistics  
 (c) Physics (d) Economics
62. Computational and statistical techniques for the analysis of biological data are studied in:  
 (a) Biomathematics (b) Biophysics  
 (c) Bioinformatics (d) Biochemistry

**ANSWER KEY**

1	d	11	b	21	b	31	b	41	b	51	c	61	b
2	b	12	d	22	b	32	c	42	d	52	b	62	c
3	b	13	a	23	d	33	a	43	c	53	c		
4	b	14	c	24	d	34	b	44	c	54	b		
5	c	15	b	25	b	35	a	45	b	55	c		
6	c	16	a	26	a	36	b	46	b	56	a		
7	c	17	c	27	b	37	c	47	d	57	b		
8	d	18	c	28	b	38	c	48	c	58	a		
9	b	19	a	29	b	39	c	49	b	59	b		
10	b	20	b	30	a	40	b	50	c	60	c		

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## Unit 2: Solving A Biological Problem

### Long Questions

**Q.1** Describe the steps involved in biological method. Text Book Page # 21, 22, 23

**Ans:** In solving a biological problem, biologist takes following steps:

1. Recognition of a biological problem
2. Observations
3. Hypothesis formulation
4. Deductions
5. Experimentation
6. Summarization of results
7. Reporting the results

**1. Recognition of a Biological Problem:**

Biologists go for adopting a biological method when they encounter some biological problem.

**Biological Problem:**

“A question related to living organisms that is either asked by some one or comes in biologist’s mind by himself is called biological problem.”

**2. Observations:**

A biologist recalls his/her previous observations or makes new ones.

**Use of Senses:**

Observations are made with five senses of:

- Vision
- Hearing
- Smell
- Taste
- Touch

**Types of observations:**

Observations may be both qualitative and quantitative. Quantitative observations are considered more accurate than qualitative ones because the former are invariable and measurable and can be recorded in terms of numbers.

**3. Formulation of Hypothesis:**

Observations do not become scientific observations until they are organized and related to a question. Biologist organizes his/her and others’ observations into data form and constructs a statement that may prove to be the answer of the biological problem under study.

**Definition:**

“A tentative explanation of the observations is called as hypothesis.”

OR

“A proposition that might be true is called hypothesis.”

**Example:**

Plasmodium is the cause of malaria.

**Characteristics:**

(GRW 2012)

A good hypothesis should have the following characteristics:



- It should be a general statement
- It should be a tentative idea.
- It should agree with available observations.
- It should be kept as simple as possible.
- It should be testable and potentially falsifiable. In other words, there should be a way to show that the hypothesis is false, a way to disprove the hypothesis.

**Reasoning:**

A great deal of careful and creative thinking is necessary for the formulation of a hypothesis. Biologists use reasoning to formulate a hypothesis.

**4. Deductions:**

In the next step, the biologist draws deductions from the hypothesis.

**Definition**

“The logical consequences of a hypothesis are called deductions.”

**Explanation:**

For formulating a deduction, a hypothesis is taken as true and expected results (deductions) are drawn from it.

Generally, in a biological method, if a particular hypothesis is true, then one should expect (deduction) a certain result. It involves the use of “if-then” logic.

**Example:**

“If plasmodium is the cause of malaria then all persons ill with malaria should have plasmodium in their blood”.

**5. Experimentation:**

The most basic step of a biological method is experimentation. A biologist performs experiments to see if hypothesis are true or not.

**Testing of hypothesis:**

The deductions which are drawn from hypothesis are subjected to rigorous testing. Through experimentation, a biologist learns which hypothesis is correct.

The incorrect hypotheses are rejected and the one which proves correct is accepted. An accepted hypothesis makes further predictions that provide an important way to further test its validity.

**Controlled Experiment:**

In science when doing the experiment, it must be a controlled experiment. The scientist must contrast an “experimental group” with a “control group”. The two groups are treated exactly alike except for the one variable being tested.

**Example:**

In an experiment to test the necessity of carbon dioxide for photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide) with an experimental group (a plant with no carbon dioxide available). The necessity of carbon dioxide will be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

**6. Summarization Of Results:**

The biologist gathers actual, quantitative data from experiments.

**Statistical Analysis**

Data for each of the groups are then averaged and compared statistically. To draw conclusions, a biologist also uses statistical analysis.

**7. Reporting The Results:**

Biologists publish their findings in scientific journals and books, in talks at international and international meetings and in seminars at colleges and universities.

**Importance:**

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

**THEORY, LAW AND PRINCIPLE****(GRW 2013)**

When a hypothesis is given repeated exposure to experimentation and is not falsified, it increases a biologist's confidence in hypothesis. Such a well-supported hypothesis may be used as the basis for formulating of further hypotheses which are again proved by experimental results.

**THEORY****Definition:**

"The hypothesis that stands the test of time (often tested and never rejected), is called a theory."

**Support of Theory:**

A theory is supported by a great deal of evidence.

A productive theory keeps on suggesting new hypotheses and so testing goes on.

Many biologists take it as a challenge and exert greater efforts to disprove the theory.

**LAW OR PRINCIPLE**

If a theory survives such doubtful approach and continues to be supported by experimental evidence, it becomes a 'Law' or 'Principle'.

- A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

**Examples:**

- Hardy-Weinberg Law
- Mendel's Laws of Inheritance

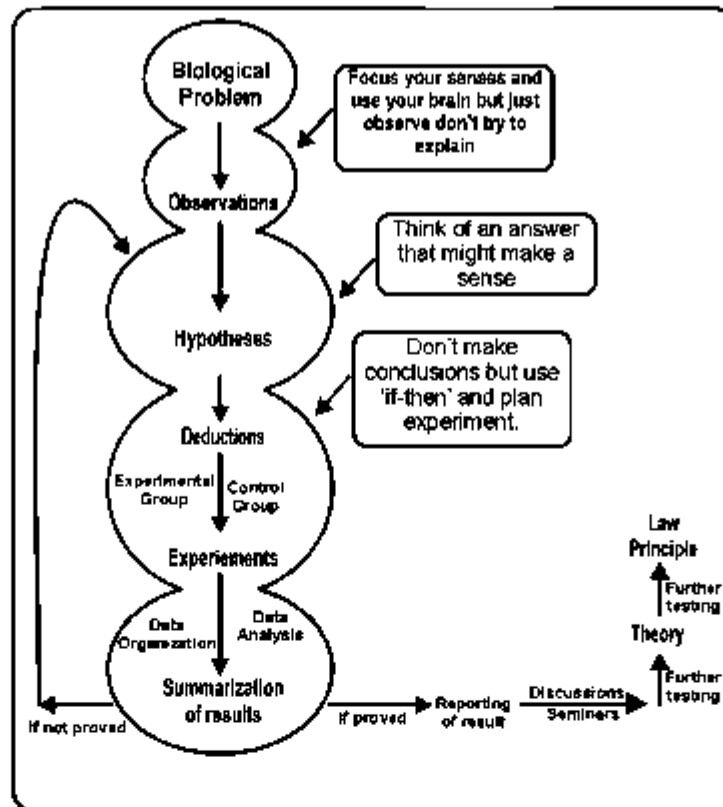


Figure: Biological Method

**Q.2 Describe the steps involved in biological method taking malaria as an example.**

**Text Book Page # 23, 24, 25, 26**

**Ans: Introduction:**

Malaria has killed more people than any other disease. The account of malaria is an example of a biological problem and of how such problems are solved.

Malaria is a common disease in many countries including Pakistan.

Steps taken to solve this problem were as follows:

**(i) Recognition of problem:**

In ancient times (more than 2000 years ago), physicians were familiar with malaria. They described it as a disease of chills and fevers with recurring attacks

**(ii) Observations about Malaria:**

In the last part of 19<sup>th</sup> century many different causes of malaria were being suggested. By that time there were four major observations about malaria.

- Malaria and marshy areas have some relation.
- Quinine is an effective drug for treating malaria.
- Drinking water from marshes does not cause malaria.
- 'Plasmodium' is seen in the blood of malarial patients.

**(iii) Hypothesis Formulation:**

A scientist uses whatever information and observation he has and makes one or more hypotheses. The hypothesis made in this case was:

*'Plasmodium is the cause of malaria'.*

(iv) **Deductions:**

A scientist does not know whether this hypothesis is true or not, but he accepts that it may be true and makes deductions. One of the deductions from the above hypothesis was:

*'If Plasmodium is the cause of malaria, then all persons ill with malaria should have Plasmodium in their blood'.*

(v) **Experimentation:**

The next step was to test the deduction through experiments which were designed as follows:

**Experimental Group:**

Blood of 100 malarial patients was examined under microscope.

**Control Group:**

Blood of 100 healthy persons was examined under the microscope.

**Results:**

The experimental results showed that almost all malarial patients had *Plasmodium* in their blood while 7 out of 100 healthy persons also had *Plasmodium* in their blood. *Plasmodium* in the blood of healthy individuals was in its incubation period i.e. the period between the entry of parasite in the host and appearance of symptoms.

The results were quite convincing and proved that the hypothesis, '*Plasmodium is the cause of Malaria*' was true.

The next biological problem was to learn about '*How Plasmodium gets into the blood of a man?*'

(i) **Observations**

Biologists were having the following observations:

- Malaria is associated with marshes.
- Drinking water of marshes does not cause malaria.

From these observations, it can be concluded that *Plasmodium* was not in the marsh water. It must be carried by something that comes to marsh water.

**Observations of A.F.A King:**

(LHR 2012)

In 1883, a physician, A.F.A King, listed 20 observations:

Some of his important observations were:

- People who slept outdoors were more likely to get malaria than those who slept indoors.
- People who slept under fine nets were less likely to get malaria than those who did not use such nets.
- Individuals who slept near a smoky fire usually did not get malaria.

(ii) **Hypothesis**

On the basis of his observations, King suggested a hypothesis:

*'Mosquitoes transmit Plasmodium and so are involved in the spread of malaria'.*

(iii) **Deductions**

Following deductions were made considering the hypothesis as true.

- (a) *'If mosquitoes are involved in the spread of malaria, then Plasmodium should be present in mosquitoes.'*
- (b) *'If mosquitoes are involved in the spread of malaria, then a mosquito can get Plasmodium by biting a malarial patient.'*

(iv) **Experiments of Ronald Ross**

In order to test the above deductions, Ronald Ross, a British army physician working in India, in 1880's, performed important experiments.

#### Experiment 1:

- He allowed a female *Anopheles* mosquito to bite a malarial patient.
- He killed the mosquito some days later.
- On examining the mosquito, *Plasmodium* was found multiplying in mosquito's stomach.

#### Experiment 2:

The next logical experiment was to allow an infected mosquito (having *Plasmodium*) bite a healthy person.

If the hypothesis was true, the healthy person would have got malaria. But scientists avoid using human beings for experiments when results can be so serious. Ross used sparrows and redesigned his experiments.

He allowed a female *Culex* mosquito to bite the sparrows suffering from malaria.

- Some of the mosquitoes were killed and studied at various times.
- Ross found that *Plasmodium* multiplied in the wall of mosquito's stomach and then moved into the mosquito's salivary glands.
- He kept some of the mosquitoes alive and allowed them to bite healthy sparrows.

#### Results:

Ross found that saliva of the infected mosquitoes contained *Plasmodia* and these entered sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

#### Experimentation on Man:

In the end, the hypothesis was tested by direct experimentation on human beings. In 1898, Italian biologists took these steps for confirmation:

- They allowed an *Anopheles* mosquito to bite a malarial patient.
- The mosquito was kept for a few days
- Then it was allowed to bite a healthy man.

#### Results:

The person later became ill with malaria.

In this way it was confirmed that mosquitoes transmit *Plasmodium* and spread Malaria.

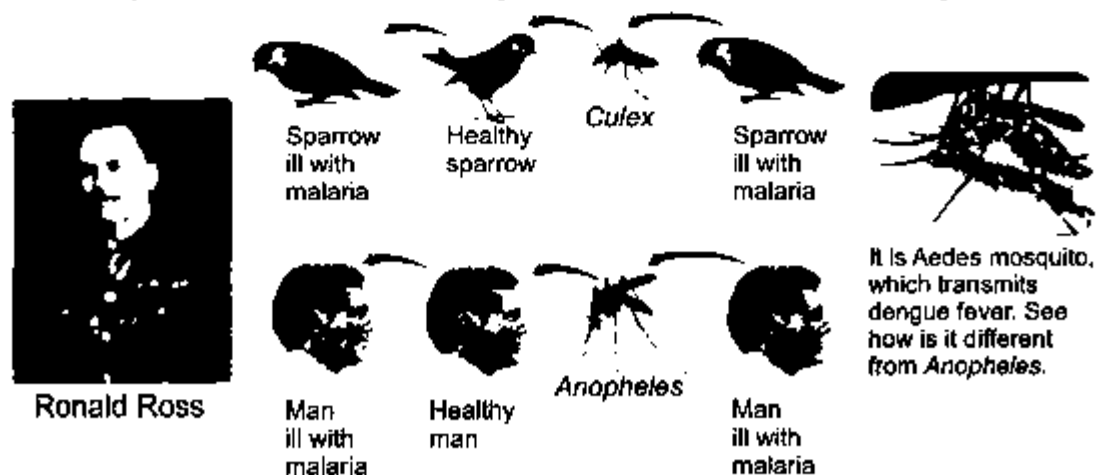


Figure: Malaria in sparrow and man is transmitted by Culex and anopheles Mosquitoes Respectively

**Q.3 Write a note on data organization.**

**Text Book Page # 28**

**Ans: DATA ORGANIZATION**

**Definition:**

“The information such as names, dates, or values made from observations and experimentation is called data.”

In order to formulate and then to test a hypothesis, scientists collect and organize data.

**Data Collection Methods:**

Prior to conducting an experiment, it is very important for a scientist to describe the data collection methods. It ensures the quality of the experiment.

**Formats:**

Data is organized into different formats like:

- Graphics
- Tables
- Flow-charts
- Maps
- Diagrams

**Q.4 Write a note on Data Analysis.**

**Ans: DATA ANALYSIS**

Data analysis is necessary to prove or disprove a hypothesis by experimentation.

**Statistical Methods:**

Data analysis is done through application of statistical methods, i.e. ratio and proportion.

**Ratio:**

When a relation between two numbers e.g. ‘a’ and ‘b’ is expressed in terms of quotient ( $a/b$ ) it is called the ratio of one number to the other.

**Expression of a ratio:**

A ratio is expressed by putting a division ( $\div$ ) or colon ( $:$ ) mark between two numbers.

**Example:**

The ratio between 50 malarial patients and 150 normal patients is 1:3.

**Proportion:**

Proportion means to join two equal ratios by the sign of equality ( $=$ )

Proportion may be expressed as  $a:b :: c:d$

**Example:**

$a:b = c:d$  is a proportion between the two ratios. This proportion may also be expressed as  $a:b :: c:d$

**Calculation of Fourth Value:**

When three values in a proportion are known, the fourth one (X) can be calculated.

**Example:**

A biologist can calculate how many birds will get malaria when he allows infected mosquitoes to bite 100 healthy sparrows. In the previous experiment he noted that when he allowed

mosquitoes to bite 20 sparrows, 14 out of them got malaria. Now he may apply the proportion rule:

**1<sup>st</sup> Ratio:** 14:20 (14 out of 20)

**2<sup>nd</sup> Ratio:** X: 100 (How many out of 100)

**Proportion:** 14:20 :: X: 100

$$\frac{X}{100} = \frac{14}{20}$$

$$X \times 20 = 100 \times 14$$

$$X = \frac{100}{20} \times 14$$

$$X = 70$$

It means, 70 out of 100 sparrows would get malaria.

**Importance of Statistics:**

Statistics are thus a means of summarizing data through the calculation of a mean value. This step is very important as it transforms raw data into information, which can be used to summarize and report results.

**Q.5** Explain Mathematics as an integral part of scientific process.

**Ans:** Biological method involves the use of applied mathematics to solve biological problems.

**Mathematical Applications:**

Major biological problems, in which knowledge of mathematics is used include:

- Gene finding
- Protein structure
- Protein-protein interactions

**Bioinformatics:**

Bioinformatics refers to the computational and statistical techniques for the analysis of biological data.

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## Unit 3: Biodiversity

### Short Questions

1. How many kinds of organisms are present on the earth?

Text Book Page # 31

**Ans:** The earth is inhabited by at least 10 million kinds of organisms, but less than one-third of these have been studied and catalogued (put in record) by biologists.

2. Name the principal groups of organisms.

**Ans:** Following are the principal groups of organisms:

- Prokaryotes
- Protists
- Fungi
- Plants
- Animals

3. Define biodiversity.

(LHR 2014, SWL 2014, FSD 2014, BWP 2015)

**Ans:** Definition:

“The measure of the variety of organisms present in different ecosystems is called biodiversity.”

- It refers to variety within species and among species.

**Meaning:**

The term ‘Biodiversity’ has been derived from two terms,

‘bio’ - Life

‘diversity’ - variety

4. What do you mean by flora and fauna?

**Ans:** Flora:

“The diversity of plants in a particular region is called Flora.”

Fauna:

“The diversity of animals in a particular region is called Fauna.”

5. On what factors the flora and fauna of a region depend?

**Ans:** The flora and fauna in a region depend on:

- Climate
- Altitude
- Soils
- Presence of other species
- 

6. How biodiversity is distributed on earth?

**Ans:** Biodiversity is not distributed evenly on Earth,

**Tropics:**

It is richest in the tropics.

**Temperate Regions:**

Temperate regions also have many species.

**Polar Regions:**

Polar regions have fewer species.

**7. How biodiversity has evolved?**

**Ans:** Biodiversity found on earth today is the result of 4 Billion years of evolution.

**8. What do you know about the origin of life on earth?**

**Ans:** The origin of life is not well known to science, though limited evidence suggests that until 600 million years ago, all life consisted of bacteria and similar unicellular organisms.

**9. Describe the importance of biodiversity.**

**Text Book Page # 32**  
**(LHR 2015, 2016, MTN 2015)**

**Ans:** The biodiversity is important in many ways.

**(i) Food:**

Biodiversity provides food for humans.

**(ii) Drugs:**

A significant proportion of drugs are derived directly or indirectly from biological sources.

**(iii) Industrial materials:**

A wide range of industrial materials, e.g. building materials, fibers, dyes, resins, gums, adhesives, rubber, and oil are derived directly from plants.

**(iv) Maintenance of Ecosystems:**

Biodiversity plays an important role in making and maintaining ecosystems.

**(v) Environmental Benefits:**

It helps in regulating the chemistry of our atmosphere and water supply.

**(vi) Recycling:**

Biodiversity is directly involved in recycling of nutrients and providing fertile soils.

**10. How many types of animals and plants are known to biologists?**

**Ans:** Over 1.5 million types of animals and over 0.5 million types of plants are known to biologists.

**11. Why does it become difficult to learn about the characteristics of each species?**

**Text Book Page # 33**

**Ans:**

- Living organisms range in complexity from small and simple bacteria to large and complex human beings.
- Some of them live in sea, others on land. Some walk, others fly. And still others are stationary.
- Each has its own way of life, i.e. getting food, avoiding unfavorable environmental conditions, finding a place to live, and reproducing its kind.

**12. How would you differentiate between systematics and taxonomy?**

(BWP 2014, RWP 2014)

**Ans:** The branch of biology which deals with classification of organisms is called Taxonomy whereas the branch of biology which deals with classification and also traces the evolutionary history of organisms is called Systematics.

**13. What are the aims of classification?**

(MTN 2015, LHR 2013, 2014, DGK 2014, SWL 2015)

**Ans:** Following are the aims of classification:

- To determine similarities and differences among organisms so that they can be studied easily.
- To find the evolutionary relationships among organisms.

**14. What do you mean by Taxa and Taxonomic hierarchy?**

(MTN 2015)

**Ans:** "The groups into which organisms are classified are called as Taxa."

- The singular of 'Taxa' is 'Taxon'.

**Example:**

The largest Taxon is kingdom

**Taxonomic Hierarchy:**

The Taxa form a ladder, called as 'Taxonomic Hierarchy'.

**15. In which species the criteria of interbreeding cannot be used? Text Book Page # 34**

**Ans:** The criteria of interbreeding cannot be used for species recognition in organisms who reproduce asexually and do not interbreed with one another.

**Example:**

- Many unicellular organisms

**16. Write the classification of human being.**

(LHR 2015, DGK 2014)

**Ans:**

Taxa	Human
Kingdom .....	Animalia
Phylum .....	Chordata
Class.....	Mammalia
Order.....	Primates
Family.....	Hominidae
Genus.....	<i>Homo</i>
Species.....	<i>H.Sapiens</i>

**17. Write the classification of pea plant.**

(LHR 2012)

**Ans:**

Taxa	Pea
Kingdom .....	Plantae
Phylum.....	Magnoliophyta
Class.....	Magnoliopsida
Order.....	Fabales
Family.....	Fabaceae
Genus.....	<i>Pisum</i>

Specie..... *P.sativum*

**18. Define specie?**

**Ans:** "A group of organisms which can interbreed freely among them and produce fertile off springs, but are reproductively isolated from all other groups in nature is called as species."

**Example:**

- Human Beings

**19. What is Mule?**

**Text Book Page # 35**

**Ans:** In the definition of species, we must emphasize "in nature" because two organisms related to two different but closely related species can cross-breed under artificial conditions. But in such unnatural crosses they produce an infertile offspring.

A cross between a male donkey and female horse produces an infertile offspring called Mule

**20. What is contribution of Aristotle in classification of living organisms?**

**Text Book Page # 36**

**Ans:** The earliest known system of classification of organisms comes from the Greek philosopher Aristotle. He classified all living organisms known at that time in two groups:

- Plantae
- Animalia

**21. Describe contribution of following scientists for classification of living organisms.**

**(i) Ibn Rushd                      (ii) Augustus Rivinus                      (iii) Andrea caesalpino**

**Ans:**

**(i) Ibn Rushd (Averroes):**

In 1172, Ibn Rushd translated Aristotle's book 'de Anima' (On the Soul) in Arabic.

**(ii) Augustus Rivinus:**

He introduced the taxon of 'order'.

**(iii) Andrea Caesalpino:**

He divided plants into fifteen groups and called them 'genera'.

**22. What do you know about classification system By Carolus Linnaeus? (LHR 2012)**

**Ans:** He grouped species according to similar physical characteristics and he divided nature into three kingdoms:

- (i) Mineral**
- (ii) Vegetable**
- (iii) Animal**

He used five ranks in classification:

- (i) Class**
- (ii) Order**
- (iii) Genus**
- (iv) Species**
- (v) Variety**

Linnaeus is best known for his introduction of the method still used to formulate the scientific name of every species.

**23. Why two kingdom classification system was rejected?**

**Ans:** Some taxonomists found this system unworkable because:

- Many unicellular organisms like *Euglena* have both plant like (presence of chlorophyll) and animal-like (heterotrophic mode of nutrition and lack of cell-wall) characters. So there should be a separate kingdom for such organisms.
- This system also ignores the difference between organisms having prokaryotic and those having eukaryotic cells.

**24. Who proposed three-kingdom classification and what were the problems with kingdom system?**

Text Book Page # 37

**Ans: Introduction:**

In 1866, Earnst Hackel solved the first objection and presented three-kingdom classification system.

**Objections:**

- This system did not clear the difference between prokaryotes and eukaryotes.
- **Fungi** were still placed in the **Kingdom Plantae**. Some biologists disagreed about the position of Fungi in kingdom Plantae. Fungi resemble plants in many ways but are not autotrophs. They are special form of heterotrophs and get their food by absorption. They do not have cellulose in their cell walls, rather they possess Chitin.

**25. What is the role of E-Chatton?**

**Ans:** In 1937, E-Chatton suggested the terms of 'Procaryotique' to describe bacteria and 'Eucaryotique' to describe animal and plant cells

**26. What is the basis of five-kingdom classification system? (BWP 2015, RWP 2014)**

**Ans:**

(i) **Cellular organization:**

The levels of cellular organization, i.e. prokaryotic, unicellular eukaryotic and multi-cellular eukaryotic.

(ii) **Modes of nutrition:**

The principle modes of nutrition, i.e. photosynthesis, absorption and ingestion.

**27. How would you differentiate between organisms of kingdom fungi and animalia?**

**Ans:**

ANIMALS	FUNGI
<ul style="list-style-type: none"> <li>• Animals have ingestive mode of nutrition.</li> <li>• Animals lack cell wall.</li> <li>• Animals are not decomposers.</li> </ul>	<ul style="list-style-type: none"> <li>• Fungi have absorptive mode of nutrition.</li> <li>• Fungi contain cell wall composed of chitin.</li> <li>• Most fungi are decomposers.</li> </ul>

**28. What type of organisms are included in kingdom Monera? Give Examples.**

(BWP 2015)

**Ans: Kingdom Monera:**

It includes prokaryotic organisms i.e. they are made of prokaryotic cells. Monerans are unicellular, although some types form chains, clusters, or colonies of cells. Most are heterotrophic but some perform photosynthesis.

**Examples:**

- Bacteria
- Cyanobacteria

**29. Write down two characteristics of kingdom protista.**

**(DGK 2015)**

**Ans: Kingdom protista:**

- It includes eukaryotic unicellular and simple multicellular organisms.
- These organisms may be photosynthetic or heterotrophic.

**30. Write two characteristics of kingdom fungi?**

**Text Book Page # 38(FSD 2015, SGD 2015)**

**Ans: Kingdom Fungi:**

- It includes eukaryotic multicellular heterotrophs which are absorptive in their nutritional mode.
- They live on organic material, secrete digestive enzymes and absorb small organic molecules.

**Examples:**

Mushrooms

**31. Describe two characteristics of kingdom plantae.**

**(GRW 2014)**

**Ans: Kingdom Plantae:**

- It includes eukaryotic multicellular autotrophs.
- They have multicellular sex organs and form embryos during their life cycles.

**Examples:**

Mosses, ferns and flowering plants are included in kingdom plantae.

**32. How can you divide five kingdoms into two groups on the basis of types of cells?**

**Ans:** Five kingdoms can be divided into two groups on basis of types of cells in following ways:

- (i) Kingdom Monera (organisms with prokaryotic cells)
- (ii) Kingdom protista, fungi, plantae, animalia (organisms with eukaryotic cells)

**33. What are prions and viroids? Text Book Page # 39 (GRW 2014, SWL 2015)**

**Ans:** Prions and viroids are acellular forms of organisms. Both of these particles cause infectious diseases in certain plants. They are not included in five-kingdom classification.

**Prions:**

They are composed of proteins only.

**Viroids:**

They are composed of circular RNA only.

**34. Clarify that viruses are living or non-living? (LIIR 2016, RWP 2015)**

**Ans:** Viruses are at the borderline of living and non living. They have both non living and living features which distinguish their unique identity.

**Non-Living Feature:**

- Due to their crystalline nature they are considered as non living.
- They are acellular i.e. they do not have cellular organization.

**Living Features:**

- They contain DNA or RNA normally encased in a protein coat.
- They reproduce, but only in living cells.
- They cause a number of diseases in living cells.

**Conclusion:**

They are not considered as organisms and thus are not assigned any place in the five-kingdom classification system.

**35. Define binomial nomenclature. (GRW 2015, MTN 2014, SWL 2015)**

**Ans: Introduction:**

Binomial nomenclature is the method of giving scientific names to living organisms.

**Meaning:**

'bi-nomial' means "two names"

**Format:**

As the word "binomial" suggests, the scientific name of a any living organism consists of two names: the first is the **genus** name and the second one is the name of the **species**.

**Example**

The Scientific name of human beings is *Homo sapiens*.

**36. State any two rules for suggesting scientific names to living organisms.**

**Text Book Page # 40**

**Ans:** Some of the rules which are universally adopted while suggesting and documenting scientific names, are:

- Scientific names are usually printed in *italics*, such as *Homo sapiens*. When handwritten, they are underlined.
- The first term (generic name) always begins with a capital letter.

**37. What are the problems with common names of living organisms?**

**Ans:** Common names have no scientific basis.

**Example:**

A fish is a vertebrate animal with fins and gills. But several common names do not fit a biologist's definition of fish like:

- Silver fish
- Cray fish
- Jelly fish
- Star fish

38. Write down scientific names of following. (MTN 2015)

(a) Onion (b) Starfish (c) House crow (d) Orchid tree

Ans: Onion ----- *Allium cepa*  
 Starfish ----- *Asterias rubens*  
 House crow ----- *Corvus splendens*  
 Orchid tree ----- *Bauhinia variegata*

39. Define Extinct species. Text Book Page # 41 (GRW 2013)

Ans: "In an ecosystem, a species is called extinct when there is no doubt that the last individual of that species has died in that ecosystem."

Example:

Dinosaurs

40. What are endangered species? Give examples.

(LHR 2012, GRW 2013, 2015, SGD 2014, FSD 2015)

Ans: A species is called endangered when it is at risk of extinction in near future.

Examples:

Indus dolphin, Marco Polo sheep, Houbara bustard.

41. Write a short note on *Eucalyptus* plants. Text Book Page # 42

Ans: *Eucalyptus* plants were imported from Australia and introduced in Pakistan. These plants consume more water and have disturbed the water table (level of underground water). It harms other small plants that grow near *Eucalyptus* trees.

42. What is the effect of deforestation on biodiversity?

Text Book Page # 43 (LHR 2016, GRW 2013)

Ans: Effects of deforestation:

Deforestation affects the amount of water in soil and moisture in atmosphere. When there are no trees to keep soil in place, there are more chances of soil erosion. Essential nutrients are washed out of soil. Rivers become choked up with mud and silt, which can cause floods. Deforestation also reduces the sources of rains.

43. What is the role of over-hunting in extinction? Text Book Page # 44 (LHR 2015)

Ans: Over-hunting has been a significant cause of the extinction of hundreds of species and the endangerment of many more such as whales, ibex, urial, markhor (the national animal of Pakistan) etc. Commercial hunting, both legal and illegal, is the principal threat.

44. What are the main causes of loss of biodiversity in Pakistan?

Ans: Pakistan today faces severe threats to its animal and plant species. The main causes of this loss are:

- Loss of natural habitats
- Rapid growth in human population
- Prevailing poverty in rural areas
- Low literacy rate



**45. Which organizations are working for the conservation of biodiversity?**

**Ans:** The following organizations are working for the conservation of biodiversity in Pakistan.

- The International Union for the Conservation of Nature and Natural Resources (IUCN)
- World Wildlife Fund Pakistan (WWF-P)
- Pakistan's Ministry of Environment
- Other government and non-government institutions

**46. Which organization has prepared first red list of Pakistan?**

**Ans:** The IUCN has prepared the first national Red List (list of endangered or threatened species).

**47. Write names of animals to which Northern Areas provide habitat.**

**Text Book Page # 45**

**Ans:** The Northern Areas of Pakistan provide habitats:

- Musk deer
- Snow leopard
- Astore markhor
- Himalayan ibex
- Woolly Flying squirrel
- Brown bear

**48. How many migratory birds are killed each year?**

**Ans:** It is estimated that about 200,000 of the one million migratory birds passing through Chitral are killed during migration.

**49. What herders do with bear cubs?**

**Ans:** The herders capture the bear cubs and sell them to the trainers who train them and sell them to the foreigners.

**50. Write a short note on Houbara Bustard.**

**Text Book Page # 46 (LHR 2013)**

**Ans:** This bird flies to Pakistan in winter season from former Soviet territory and settles in Cholistan and Thar deserts. The decline in its population is due to hunting by foreigners and destruction of its habitats.

**51. Name the national animal and bird of Pakistan.**

**(LHR 2013, SWL 2014, RWP 2015)**

**Ans: National Animal:**

Markhor is the national animal of Pakistan.

**National Bird:**

Chakor partridge is the national bird of Pakistan.

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## Unit 3: Biodiversity

### Multiple Choice Questions

1. How many kinds of organisms inhabit the earth? Text Book Page # 31  
(a) 10 million (b) 15 million  
(c) 20 million (d) 25 million
2. The plants present in a particular region:  
(a) Flora (b) Fauna  
(c) Species (d) Population
3. The animals present in a particular region:  
(a) Flora (b) Fauna  
(c) Species (d) Both a and b
4. Biodiversity found on earth today is the result of how many years of evolution?  
(a) 3 billion (b) 4 billion  
(c) 5 billion (d) 6 billion
5. The branch of Biology which deals with classification and traces the evolutionary history of organisms: Text Book Page # 33  
(a) Taxonomy (b) Systematics  
(c) Histology (d) Entomology
6. Which of the following is highest taxon of classification? Text Book Page # 34 (GRW 2013)  
(a) Species (b) Genus  
(c) Order (d) Family
7. A class is a group of related:  
(a) Phylum (b) Order  
(c) Family (d) Genus
8. A related group of genera comprises: (LHR: 2012)  
(a) Phylum (b) Class  
(c) Family (d) Order
9. A genus is a group of related:  
(a) Class (b) Family  
(c) Order (d) Species
10. A family is a group of related: (MTN 2015, GRW 2014, LHR 2013, DGK 2015)  
(a) Genera (b) Orders  
(c) Species (d) Classes
11. A group of related species is: (SWL 2014)  
(a) Kingdom (b) Phylum  
(c) Genus (d) Order
12. The order of pea plant:  
(a) Pisum (b) Fabales  
(c) Magnoliophyta (d) Fabaceae
13. The family of human being:  
(a) Chordata (b) Mammalia  
(c) Primates (d) Hominidae

14. The order of human according to classification is: (BWP 2015)  
 (a) Mammalia (b) Primates  
 (c) Homonidae (d) Pisum
15. The basic unit of classification: (DGK 2014)  
 (a) Order (b) Family  
 (c) Genus (d) Species
16. Who introduced the system of classification of organisms for the first time? (LHR 2015)  
 (a) Ernst Hackel (b) Aristotle  
 (c) Carlous Linnaeus (d) Robert Whittaker
17. The smallest taxon of taxonomy is: (GRW: 2012)  
 (a) Family (b) Order  
 (c) Species (d) Kingdom
18. The cross between a male donkey and a female horse produces: Text Book Page # 35  
 (a) Mule (b) Pony  
 (c) Liger (d) Tiger
19. The animal unable to reproduce is: (GRW 2015)  
 (a) Monkey (b) Mule  
 (c) Horse (d) Donkey
20. Divided plants into fifteen groups and called them "genera": Text Book Page # 36  
 (a) John Ray (b) Tournefort  
 (c) Carolus Linnaeus (d) Andrea Caesalpino
21. Who introduced the taxon of "order"? (DGK 2014)  
 (a) Tournefort (b) Carolus Linnaeus  
 (c) Augustus Rivinus (d) Aristotle
22. Carolus linnaeus divided nature into \_\_\_\_\_ Kingdom? (RWL 2015)  
 (a) Three (b) Four  
 (c) Five (d) Six
23. In which year three kingdom classification system was proposed? Text Book Page # 37  
 (a) 1860 (b) 1862  
 (c) 1864 (d) 1866
24. Who proposed three kingdom classification system? (FSD 2015)  
 (a) E-Chatton (b) Robert Whittaker  
 (c) Ernst Hackel (d) Margulis
25. Bacteria are assigned to the kingdom: (LHR 2015)  
 (a) Fungi (b) Monera  
 (c) Protista (d) Porifera
26. Which of the following group includes organisms all of which are prokaryotes? (DGK 2014)  
 (a) Plants (b) Bacteria  
 (c) Protists (d) Animals
27. In which year five kingdom classification system was proposed?  
 (a) 1965 (b) 1966  
 (c) 1967 (d) 1968
28. Who proposed five kingdom classification system? (SGD 2014)  
 (a) E-Chatton (b) Robert Whittaker  
 (c) Ernst Hackel (d) Margulis
29. Five-kingdom classification system of whittaker was modified by: Text Book Page # 38  
 (a) Margulis (b) Schwartz  
 (c) E-chatton (d) Both a and b

30. Which organism is included in kingdom monera? (SRG 2014)  
 (a) Cyanobacteria (b) Algae  
 (c) Fungi (d) Virus
31. According to Biologists, the protists are the ancestors of:  
 (a) Plantae (b) Fungi  
 (c) Animalia (d) All of these
32. Kingdom Protista includes: (SWL 2015)  
 (a) Eukaryotic unicellular (b) Simple multicellular  
 (c) Eukaryotic multicellular (d) Both a and b
33. Nuclear envelope is absent in: Text Book Page # 39  
 (a) Monera (b) Protista  
 (c) Fungi (d) Plantae
34. Viruses belong to kingdom: (GRW 2013, LHR 2013)  
 (a) Monera (b) Protista  
 (c) Fungi (d) None of these
35. Which organisms are composed of only proteins?  
 (a) Prions (b) Viroids  
 (c) Fungi (d) Algae
36. Which of these is acellular particle? (LHR 2016)  
 (a) Human (b) Bacteria  
 (c) Fungi (d) Virus
37. The organisms that are composed of circular RNA only?  
 (a) Prions (b) Viroids  
 (c) Fungi (d) Algae
38. The cell wall of fungi is made up of:  
 (a) Chitin (b) Cellulose  
 (c) Peptidoglycan (d) Lignin
39. Common example of kingdom fungi is: (MTN 2015)  
 (a) Mushroom (b) Fern  
 (c) Algae (d) Mosses
40. Who first introduced and adopted the system of binomial nomenclature?  
 (a) E-chatton (b) Robert Whittaker  
 (c) Carolus linnaeus (d) Margulis
41. *Bauhinia variegata* is an ornamental tree found in: Text Book Page # 40  
 (a) North Asia (b) South Asia  
 (c) Southeast Asia (d) All of these
42. Scientific name of onion: (SGD 2014, GRW 2015, LHR 2012, 2014)  
 (a) *Allium cepa* (b) *Asterias rubens*  
 (c) *Corvus splendens* (d) *Homo sapiens*
43. Scientific name of house crow:  
 (a) *Allium cepa* (b) *Asterias rubens*  
 (c) *Corvus splendens* (d) *Homo sapiens*
44. Scientific name of star fish:  
 (a) *Allium cepa* (b) *Asterias rubens*  
 (c) *Corvus splendens* (d) *Homo sapiens*
45. What was the population of earth 10,000 years ago? Text Book Page # 41  
 (a) 2 million (b) 3 million  
 (c) 4 million (d) 5 million
46. How many people are added in human population each day?  
 (a) 240,000 (b) 250,000  
 (c) 260,000 (d) 270,000
47. Number of persons increasing in the world population after every minute is: (RWL 2014)  
 (a) 180 (b) 290  
 (c) 280 (d) 490

48. A species that no longer lives in an ecosystem is called: (LHR: 2014)  
 (a) Endangered species (b) Global ecosystem  
 (c) Extinct species (d) Population
49. The greatest cause of species extinction is: Text Book Page # 42  
 (a) Hunting (b) Species introduction  
 (c) Habitat destruction (d) None of these
50. The greatest threat to biodiversity on earth today:  
 (a) Species introduction (b) Pollution  
 (c) Habitat Loss (d) Hunting
51. Which organization prepared the first national Red List of Pakistan? Text Book Page # 44  
 (a) WWF-P (b) IUCN  
 (c) NACP (d) IIJP
52. Pakistan signed UN Convention on Combating Desertification in:  
 (a) 1995 (b) 1996  
 (c) 1997 (d) 1998
53. When was Himalayan Jungle Project started? Text Book Page # 45  
 (a) 1990 (b) 1991  
 (c) 1992 (d) 1993
54. How many birds are killed in Chitral during migration?  
 (a) 100,000 (b) 200,000  
 (c) 300,000 (d) 400,000
55. How many animals of Indus Dolphin are left today in the Indus river?  
 (a) 300 (b) 400  
 (c) 500 (d) 600
56. *Houbara bustard* flies to Pakistan in: Text Book Page # 46  
 (a) Summer (b) Spring  
 (c) Autumn (d) Winter
57. The National animal of Pakistan: Book Page # 47 (BWP 2015, LHR 2016)  
 (a) Markhor (b) Snow leopard  
 (c) Tiger (d) Brown bear
58. The National bird of Pakistan: (SWI. 2015, LHR 2016)  
 (a) Markhor (b) Pigeon  
 (c) Chakor partridge (d) Brown bear

#### ANSWERS KEY

1	a	11	c	21	c	31	d	41	c	51	b
2	a	12	b	22	a	32	d	42	a	52	c
3	b	13	d	23	d	33	a	43	c	53	b
4	b	14	b	24	c	34	d	44	b	54	b
5	b	15	d	25	b	35	a	45	d	55	d
6	c	16	b	26	b	36	d	46	c	56	d
7	b	17	c	27	c	37	b	47	a	57	a
8	c	18	a	28	b	38	a	48	c	58	c
9	d	19	b	29	d	39	a	49	b		
10	a	20	d	30	a	40	c	50	c		

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## **Unit 3: Biodiversity**

### **Long Questions**

**Q.1** What is classification? Describe its aims and basis. Text Book Page # 33  
(GRW 2014), (DGK 2014, 2015)

**Ans:**

#### **CLASSIFICATION**

To study large collection of living organisms, biologists classify organisms into groups and subgroups.

#### **Biological Classification:**

The method by which biologists divide organisms into groups and subgroups on the basis of their similarities and differences is called biological classification.

#### **Taxonomy:**

The branch of biology which deals with classification of organisms is called Taxonomy.

#### **Systematics:**

The branch of biology which deals with classification and also traces the evolutionary history of organisms is called Systematics.

#### **AIMS OF CLASSIFICATION**

Following are the aims of classification:

- To determine similarities and differences among organisms so that they can be studied easily.
- To find the evolutionary relationships among organisms.

#### **BASIS OF CLASSIFICATION**

Classification is based on relationships amongst organisms and such relationship is got through similarities in characteristics. These similarities suggest that all organisms are related to one another at some point in their evolutionary histories. However, some organisms are more closely related than others.

#### **Example:**

Sparrows are more closely related to pigeons than to insects. It means that the former two have common evolutionary histories.

#### **Similarities:**

When biologists classify organisms into groups and subgroups, similarities are seen in:

- External structures
- Internal structures
- Stages of development

#### **Role of Modern Genetics:**

Modern genetics provides important information to taxonomists. The similarities and differences in the DNA of two studied organisms can be used for getting idea about similarities and differences in their structure and functions.



Q.2 Write a note on Taxonomic Hierarchy.

Ans: **TAXONOMIC HIERARCHY**

**Taxa:**

The groups into which organisms are classified are called as Taxa.

- The singular of 'Taxa' is 'Taxon'.

**Taxonomic Hierarchy:**

The taxa form a ladder, called as 'Taxonomic Hierarchy'.

**Divisions of Organisms:**

All organisms are divided into 5 kingdoms. So kingdom is the largest taxon. On the basis of similarities, each kingdom is further divided into smaller taxa in the following way:

**Kingdom:**

A kingdom is a group of related phyla.

**Phylum:**

A phylum is a group of related classes. (**Division:** For plants & fungi)

**Class:**

A class is a group of related orders.

**Order:**

An order is a group of related families.

**Family:**

A family is a group of related genera.

**Genus:**

A genus is a group of related species.

**Species:**

A species consists of similar organisms.

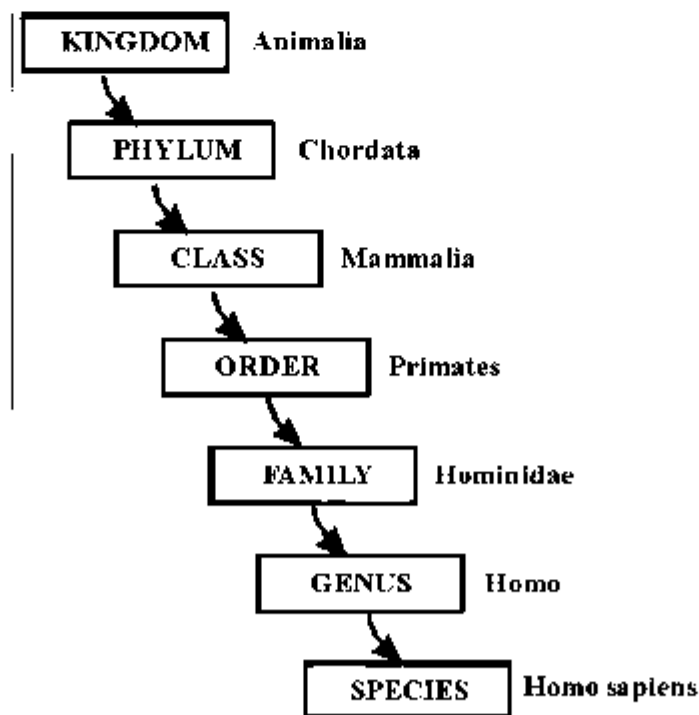


Figure: Taxonomic Hierarchy

**Q.3 Write a note on species.**

**Text Book Page # 34**

**Ans:**

### **SPECIES**

#### **Introduction:**

Species is the basic unit of classification.

#### **Definition:**

A group of organisms which can interbreed freely among them and produce fertile offsprings, but are reproductively isolated from all other groups in nature is called as species.

#### **Distinct characteristics:**

Each species possesses its own distinct characteristics like:

- Structural
- Ecological
- Behavioral

#### **Explanation:**

In the definition of species, we must emphasize "in nature" because two organisms related to two different but closely related species can cross-breed under artificial conditions. But in such unnatural crosses they produce an infertile offspring.

#### **Example:**

A cross between a male donkey and a female horse produces an infertile offspring.

- Mule

#### **Interbreeding Criteria:**

The criteria of interbreeding cannot be used for species recognition in organisms who reproduce asexually and do not interbreed with one another.

#### **Example:**

- Many unicellular organisms

**Q.4 What do you know about history of Classification systems? Text Book Page # 36**

**Ans:**

### **HISTORY**

The following scientists contributed in past for development of classification systems:

**(i) Aristotle:**

The earliest known system of classification of organisms comes from the Greek philosopher Aristotle. He classified all living organisms known at that time in two groups:

- Plantae
- Animalia

**(ii) Abu-Usman Umer Aljahiz:**

In 700s, Abu-Usman Umer Aljahiz described the characteristics of 350 species of animals in his book. He wrote a lot about the life of ants.

**(iii) Ibn Rushd (Averroes):**

In 1172, Ibn Rushd translated Aristotle's book 'de Anima' (on the soul) in Arabic.

**(iv) Andrea Caesalpino:**

#### **Period:**

He was born in 1519AD and died in 1603 AD.

#### **Contribution:**

- He divided plants into fifteen groups and called them 'genera'.
- (v) **John Ray:**  
**Period:**  
He was born in 1627 AD and died in 1705 AD.  
**Contribution:**  
He published important work on plant classification.
- (vi) **Augustus Rivinus:**  
**Period:**  
He was born in 1652 AD and died in 1723 AD.  
**Contribution:**  
He introduced the taxon of 'order'.
- (vii) **Tournefort:**  
**Period:**  
He was born in 1656 AD and died in 1708 AD.  
**Contribution:**  
He introduced the taxa of 'class' and 'species'.
- (viii) **Carolus Linnaeus:**  
**Period:**  
He was born in 1707 AD and died in 1778 AD.  
**Contribution:**  
He grouped species according to similar physical characteristics and divided nature into three kingdoms:
- (i) Mineral
  - (ii) Vegetable
  - (iii) Animal
- He used five ranks in classification:
- (i) Class
  - (ii) Order
  - (iii) Genus
  - (iv) Species
  - (v) Variety

Linnaeus is best known for his introduction of the method still used to formulate the scientific name of every species.

**Preference of a System:**

Biologists prefer such a system that can provide maximum information about the basic differences and similarities among different organisms.

**Q.5** Write a note on two-kingdom classification system. Text Book Page # 36(SWL 2015)

**Ans:** **TWO-KINGDOM CLASSIFICATION SYSTEM**

**Introduction:**

It is the oldest of all the classification systems.

According to this system, all organisms are classified into two kingdoms:

**(i) Kingdom Plantae:**

- These organisms can prepare food from simple inorganic materials.
- They can store energy.
- They are autotrophs.
- Bacteria, fungi, and algae were included in Kingdom Plantae.

**(ii) Kingdom Animalia:**

- These organisms cannot synthesize their own food.
- They depend on autotrophs or other organisms for their food.
- They are heterotrophs.

**Objections:**

Some taxonomists found this system unworkable because:

- Many unicellular organisms like *Euglena* have both plant like (presence of chlorophyll) and animal-like (heterotrophic mode of nutrition and lack of cell wall) characters. So there should be a separate kingdom for such organisms.
- This system also ignores the difference between organisms having prokaryotic and those having eukaryotic cells.

**Q.6** Write a note on three-kingdom classification system.

Text Book Page # 37  
(BWP 2015)

**Ans:** **THREE-KINGDOM CLASSIFICATION SYSTEM**

**Introduction:**

In 1866, Ernst Haeckel solved the first objection and presented three-kingdom classification system.

According to this system, all organisms are classified into three kingdoms:

**(i) Kingdom Plantae:**

He placed all plants and fungi in this kingdom.

**(ii) Kingdom Animalia:**

All of the animals were placed in kingdom animalia.

**(iii) Kingdom Protista:**

He proposed a third kingdom, Protista to accommodate *Euglena*-like organisms. He also included bacteria in this kingdom.

**Objections:**

- This system did not clear the difference between prokaryotes and eukaryotes.
- Some biologists disagreed about the position of Fungi in kingdom Plantae. Fungi resemble plants in many ways but are not autotrophs. They are special form of heterotrophs and get their food by absorption. They do not have cellulose in their cell walls, rather they possess Chitin.

**Q.7** Write a note on five-kingdom classification system.

Text Book Page # 37+38  
(BWP 2014), (SGD 2015)

**Ans:** **FIVE-KINGDOM CLASSIFICATION SYSTEM**

**Introduction:**

In 1967, Robert Whittaker introduced the five-kingdom classification system. This system is based on:

**(i) Cellular organization:**

The levels of cellular organization, i.e. prokaryotic, unicellular eukaryotic and multi-cellular eukaryotic.

**(ii) Modes of nutrition:**

The principle modes of nutrition, i.e. photosynthesis, absorption, and ingestion.

**Number of Kingdoms:**

Organisms are divided into the following five kingdoms:

1. Monera
2. Protista
3. Fungi
4. Plantae
5. Animalia

**Modification:**

In 1988, Margulis and Schwartz modified the five-kingdom classification of Whittaker. They considered genetics along with cellular organization and modes of nutrition in classification. They classified the organisms into the same five kingdoms as proposed by Whittaker.

**THE FIVE KINGDOMS**

**1. Kingdom Monera:**

(LHR 2013)

- It includes prokaryotic organisms i.e. they are made up of prokaryotic cells.
- They are unicellular.
- Some may form chains, clusters or colonies of cells.
- Most of them are heterotrophic.
- Some perform photosynthesis because of presence of chlorophyll in cytoplasm.
- They are radically different from eukaryotic cells.

**Examples:**

In this kingdom, there are two kinds of organisms:

- Bacteria
- Cyanobacteria

**2. Kingdom Protista:**

(LHR 2014)

It includes eukaryotic organisms, which are unicellular or simple multicellular.

**Types of Protists:**

There are three main types of protists:

**(i) Algae:**

- They are unicellular, colonial, or simple multicellular.
- They resemble plant cells with cell walls and chlorophyll in chloroplasts.
- Simple multicellular means that they do not have multicellular sex organs and do not form embryos during life cycle.

**(ii) Protozoans:**

- They resemble animals.
- Their cells lack cell walls and chlorophyll.

**(iii) Fungi-like:**

- Some protists resemble fungi.

**3. Kingdom Fungi:**

- It includes eukaryotic multicellular heterotrophs.
- They are absorptive in their mode of nutrition.
- Most fungi are decomposers. They live on organic material, secrete digestive enzymes, and absorb small organic molecules formed by the digestion by enzymes.

**Examples:**

- Mushrooms

**4. Kingdom Plantae:****(I.H.R 2014)**

- It includes eukaryotic multicellular autotrophs.
- Plants are autotrophic in nutritional mode.
- They make their own food by photosynthesis.
- They have multicellular sex organs.
- They form embryos during their life cycles.

**Examples:**

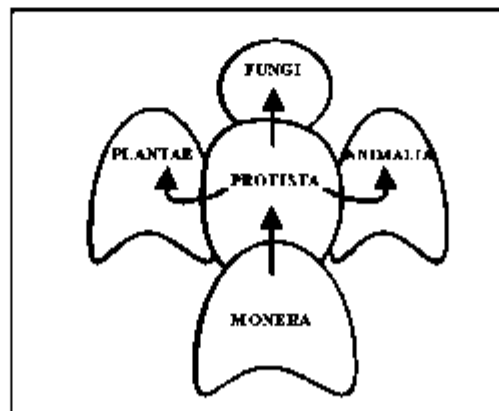
- Mosses
- Ferns
- Flowering plants

**5. Kingdom Animalia:**

- It includes eukaryotic multicellular consumers.
- They live mostly by ingesting food and digesting it within specialized cavities.
- They lack cell walls.
- They show movements.

**Examples:**

- Rabbit
- Starfish
- Monkey

**Figure: The Five Kingdoms of Classification****Opinion of Biologists:**

Biologists believe that kingdom protista evolved from monera, and it gave rise to the other three eukaryotic kingdoms, i.e. fungi, plantae and animalia.

**Q.8 Compare the distinguishing characteristics of the five kingdoms of life.**

**Text Book Page # 39**

**Ans:**

**CHARACTERISTICS**

<b>Kingdom</b>	<b>Cell Type</b>	<b>Nuclear Envelope</b>	<b>Cell Wall</b>	<b>Mode of Nutrition</b>	<b>Multi-Cellularity</b>
<b>Monera</b>	Prokaryotic	Absent	Non-cellulose (polysaccharide plus amino acids)	Autotroph or heterotroph	Absent
<b>Protista</b>	Eukaryotic	Present	Present in some forms, various types	Photosynthetic or heterotroph, or combination	Absent in most forms
<b>Fungi</b>	Eukaryotic	Present	Chitin	Absorptive heterotroph	Present in most forms
<b>Plantae</b>	Eukaryotic	Present	Cellulose and other polysaccharides	Photosynthetic	Present in all forms
<b>Animalia</b>	Eukaryotic	Present	Absent	Ingestive heterotroph	Present in all forms

**Q.9 Write a note on status of viruses.**

**(I.H.R 2014)**

**Ans:**

**STATUS OF VIRUSES**

Viruses are at the borderline of living and non-living. They have both non-living and living features which distinguish their unique identity.

**Non-Living Feature:**

- Due to their crystalline nature they are considered as non living.
- They are acellular i.e. they do not have cellular organization.

**Living Features:**

- They contain DNA or RNA normally encased in a protein coat.
- They reproduce, but only in living cells.
- They cause a number of diseases in living cells.

**Conclusion:**

They are not considered as organisms, and thus are not assigned any place in the five-kingdom classification system.

**Q.10 Write a note on binomial nomenclature.**

**Text Book Page # 39+40**

**(LHR 2015), (BWP 2015), (FSD 2014)**

**Ans:**

**BINOMIAL NOMENCLATURE**

**Introduction:**

Binomial nomenclature is the method of giving scientific names to living organisms.

**Meaning:**

'bi-nomial' means 'two names'

**Format:**

As the word "binomial" suggests, the scientific name of any living organism consists of two names: the first is the **genus** name and the second one is the name of the **species**.

Swedish biologist Carolus Linnaeus (1707-1778 AD) first introduced and adopted the system of binomial nomenclature. His system spread rapidly and became popular. Many of his names are in use today.

**Rules**

Some of the rules which are universally adopted while suggesting and documenting scientific names, are:

- Scientific names are usually printed in *italics*, such as *Homo sapiens*. When handwritten, they are underlined.
- The first term (generic name) always begins with a capital letter.  
The species name is never capitalized, even when derived from a proper name.
- The scientific name is generally written in full when it is first used. But when several species from the same genus are being listed, it may then be abbreviated by just using an initial for genus. For example, *Escherichia coli* becomes *E. coli*.

**SIGNIFICANCE**

**Different Names of Same Organism:**

Different regions have different names for the same organism.

**Example:**

Common name of onion in Urdu is 'piyaz', but in different regions of Pakistan it is also known as 'ganda' or 'bassal' or 'vassal'. In other countries, it has other sets of names. In science, it is known with a single name as *Allium cepa*.

**Same Name for Different Organisms:**

In some cases, different organisms are called by the same common name.

**Example:**

The name 'black bird' is used both for crow as well as raven.

**Common Names:**

Common names have no scientific basis.

**Example:**

A fish is a vertebrate animal with fins and gills. But several common names do not fit a biologist's definition of fish like:

- Silver fish
- Cray fish
- Jelly fish
- Star fish

**Name in the Honour of Scientist:**



Sometimes organisms are named in honor of the research workers who described and classified them.

**Example:**

The Orchid tree, (Mountain-ebony) was named as *Bauhinia variegata* after the Swiss botanist Bauhin. *Bauhinia variegata* is an ornamental tree found in south-east Asia.

**Advantages:**

- Organisms can be given proper scientific names by binomial nomenclature.
- The value of this system is that it is widely used.
- This system gives stability to an organism's identification.
- Every organism can be unambiguously identified with just two words.
- Same names can be used all over the world, in all languages avoiding difficulties of translation.

**Examples:**

Common Name	Scientific Name
Onion.....	<i>Allium cepa</i>
Common sea-star (Starfish).....	<i>Asterias rubens</i>
House crow.....	<i>Corvus splendens</i>

**Q.11 Write a note on Conservation of Biodiversity. Text Book Page # 41 (SGD 2014)**

**Ans:**

**CONSERVATION OF BIODIVERSITY**

**Loss of Biodiversity:**

During the last century, loss of biodiversity has been increasingly observed. In the modern era, due to human actions, species and ecosystems are threatened with destruction to an extent rarely seen in Earth history.

Biologists warn that global ecosystem would collapse if biodiversity continues to be reduced at the same rate.

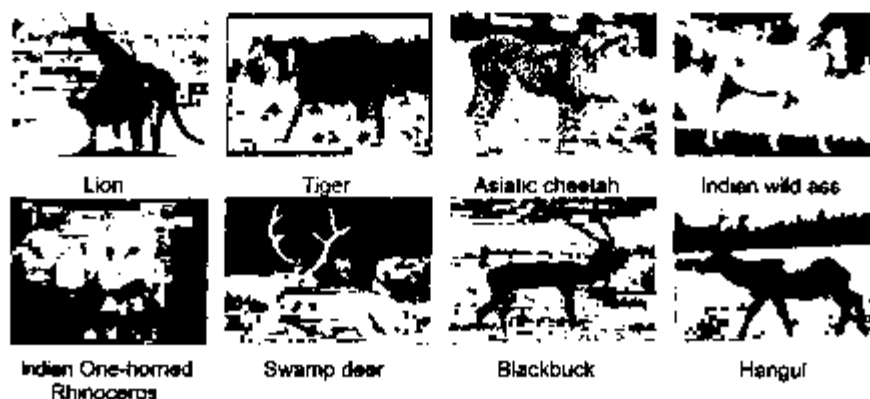
**An Extinct Species:**

In an ecosystem, a species is called extinct when there is no doubt that the last individual of that species has died in that ecosystem.

When species of an ecosystem becomes extinct, the stability of that ecosystem is harmed.

**An Endangered Species:**

A species is called 'endangered' when it is at risk of extinction in the near future.



**Figure: The Animals the have gone Extinct in Pakistan**

**Examples:**

Many plant and animal species have gone extinct in Pakistan. Examples of extinct and endangered animal species are:

- Lion
- Tiger
- Asiatic cheetah
- Indian one-horned rhinoceros
- Swamp deer
- Indian wild ass
- Hangul
- Blackbuck

**Q.12 Describe impact of human beings on biodiversity.**

**Text Book Page # 41+42  
(MTN 2015), (FSD 2014)**

**Ans:**

**IMPACT OF HUMAN BEINGS**

**Growth in human Population:**

By 10, 000 years ago, there were about 5 million people on Earth.

With the advancement in agriculture and industry, human population began to grow rapidly.

Today around 600 million people live on Earth.

More than 260,000 people are added to the world population each day, or more than 180 each minute.

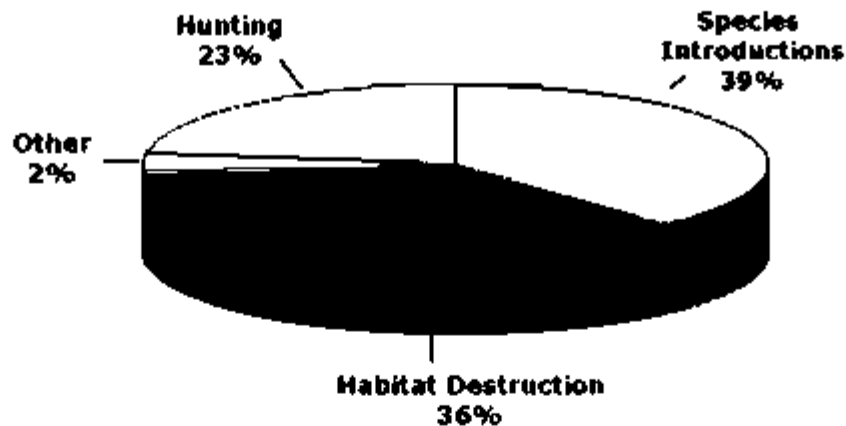
**Threats to Biodiversity:**

To improve the living conditions for 600 million individuals, humans are imposing serious threats to the survival of biodiversity.

- Habitat loss
- Deforestation
- Over-hunting
- Introduction of new species
- Removal of species
- Pollution
- Climate change

**Greatest Threat:**

Habitat loss is the greatest threat to the biodiversity.



**Figure: Known causes of species extinction**

#### Removal of Sea Stars from Ocean:

Sea star (starfish) eats mussels. If sea stars are removed from a region in an ocean, mussels rapidly increase in number. Large number of mussels prey on small animals and become dangerous for their existence.



#### Hazard from *Eucalyptus* Plant:

*Eucalyptus* plants were imported from Australia and introduced in Pakistan. These plants consume more water and have disturbed the water-table (level of underground water). It harms other small plants that grow near *Eucalyptus* trees.



**Q.13 Write a note on Deforestation and Over-Hunting.**

**Text Book Page # 43+44**

**Ans:**

#### **DEFORESTATION**

##### **Definition:**

“The cutting down of trees for the conversion of a forest to a non-forest land is called deforestation.”

The destruction of the significant areas of forests has resulted in:

- Degraded environment

- Reduced biodiversity

Sometimes there is slow forest degradation and sometimes sudden and catastrophic clear cutting for urban development.

**Causes:**

Deforestation can be the result of deliberate removal of forests for:

- Wood
- Agriculture
- Urban development
- The race to produce cash through fruits, spices, sugar, tobacco, soap, rubber, paper and cloth have stimulated many to get them by using soil and destroying the forests.

**EFFECTS OF DEFORESTATION**

**Amount of Water:**

Deforestation affects the amount of water in soil and moisture in the atmosphere.

**Soil Erosion:**

When there are no trees to keep soil in place, there are more chances of soil erosion.

**Loss of Nutrients:**

Heavy rainfall washes this soil into rivers. Essential nutrients are washed out of soil.

**Flooding:**

Rivers become choked up with mud and silt, which can cause floods.

**Decreased Capacity of Dams:**

The silted water gets stored in dams and it reduces their water storage capacity.

**Decreased Transpiration:**

Deforestation contributes to decreased transpiration, which lessens cloud-formation. This ultimately reduces the sources of rains.

**Long Term Losses:**

Short-term economic gains made by conversion of forest to agriculture often leads to loss of long-term income.

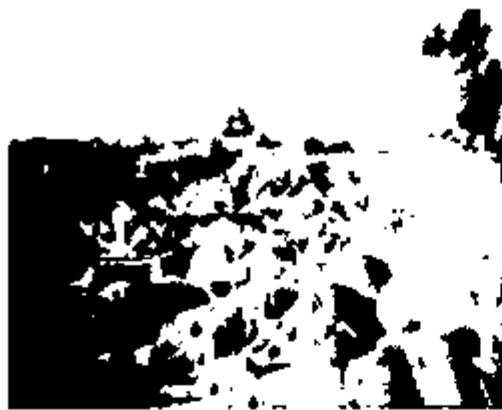
**Importance of Forests:**

The following important aspects of forests are being harmed due to deforestation:

- Forests support considerable biodiversity.
- The utilization of forest products, like timber and fuel-wood, has played a key-role in human societies. In developing countries, almost 3 billion people rely on wood for heating and cooking.
- Developed countries today continue to utilize timber for building houses.
- Wood pulp is used for making paper.
- Forests extract carbon dioxide and pollutants from air, thus contributing to biosphere stability.
- Forests are also valued for their aesthetic beauty and tourist attraction.

**Deforestation in Khyber Pakhtunkhwa:**

In the province Khyber Pakhtunkhwa, the closed canopy forests are shrinking at approximately 1% per year.



**Figure: Soil erosion**



**Figure: Chopping up of trees for the construction of road**

### **OVER-HUNTING**

Overhunting has been a significant cause of the extinction of hundreds of species and the endangerment of many more such as:

- Whales
- Ibex
- Urial
- Markhor (the national animal of Pakistan)

#### **Principal Threat:**

Commercial hunting, both legal and illegal, is the principal threat.

**Q.14 Explain the steps taken for the conservation of biodiversity. Text Book Page # 44+45**

**Ans:**

### **STEPS FOR THE CONSERVATION OF BIODIVERSITY**

Though rich in biodiversity, Pakistan today faces severe threats to its animal and plant species.

#### **Organizations:**

The International Union for the Conservation of Nature and Natural Resources (IUCN) and World Wildlife Fund-Pakistan (WWF-P) work in close coordination with Pakistan's Ministry of Environment and other government and non-government institutions.

#### **Red List:**

The IUCN has prepared the first national Red List (list of endangered or threatened species). Following are a few examples of environmental work that has been carried out in Pakistan in order to conserve species and associated habitats.

**1. National Conservation Strategy:**

In 1980's, IUCN and the government of Pakistan formulated the National Conservation Strategy for Pakistan for the conservation of Pakistan's biodiversity.

**2. UN Convention on Combating Desertification (CCD):**

This is an international treaty against damage and poverty in drylands. Pakistan signed this in 1997.

**3. Himalayan Jungle Project (HJP):**

It started in 1991 in the Palas Valley, in Khyber Pakhtunkhwa (KP). It aimed at protecting one of the richest areas of biodiversity in Pakistan.

**4. Conservation of biodiversity of the Sulaiman Range, Balochistan:**

Suleiman Range Chilghoza Forest is the largest Chilghoza forest in the world. In 1992, the WWF-P started its conservation program.

**5. Northern Areas Conservation Project:**

The northern areas of Pakistan serve as a habitat for a number of wildlife species. The survival of these species is under threat. The NACP is a project of WWF-P which is successful in implementing a ban on the hunting of these species.

**6. Conservation of Migratory Birds in Chitral, KP:**

Chitral lies on the migratory route of several important bird species. These birds face enormous hunting pressure. WWF-P initiated efforts to reduce the hunting pressure in 1992. The efforts proved successful.

**7. Conservation of Chiltan Markhor:**

Hazarganji National Park is located close to Quetta and is the only remaining habitat of Chiltan Markhor in the country. WWF-P developed the management plan of the park.

**8. Ban on Games:**

Foreigners visit the northern areas and play many games in which bears are used. WWF-P has been successful in imposing a ban on this illegal practice.

**Q.15 Write a note on endangered species in Pakistan. Text Book Page # 45+46  
(SWL 2015), (MTN 2015), (SGD 2014), (RWP 2015)**

**Ans: ENDANGERED SPECIES IN PAKISTAN**

Due to human activities, biodiversity in Pakistan is facing a huge loss. Here are a few examples of endangered species in Pakistan:

**(i) Indus Dolphin:**

According to WWF-P, only 600 animals of the species of Indus Dolphin are left in the Indus River.

**Reasons:**

The population of this species declined due to:

- Water pollution
- Poaching
- Destruction of habitat

**(ii) Marco Polo Sheep:**

Marco Polo sheep are mostly found in the Khunjerab National Park and nearby areas.

**Steps for conservation:**

Their numbers have been rapidly decreasing in the last two decades and WWF-P has started projects for its conservation.

**(iii) Houbara Bustard:**

This bird flies to Pakistan in the winter season from former Soviet territory and settles in Cholistan and Thar deserts.

**Decrease in population:**

The decline in its population is due to hunting by foreigners and destruction of its habitats.

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## Unit 4: Cells and Tissues

### Short Questions

**1. Define Microscopy and describe the invention of first microscope. Text Book page#52**

**Ans: Microscopy:**

“The use of microscope is called microscopy.”

The first compound microscope was developed by Zacharias Janssen in Holland in 1595.

**Structure:**

It was simply a tube with lenses at each end and its magnification ranged from 3X to 9X.

**2. Define Magnification.**

(SWL 2014, SGD 2015, RWP 2015)

**Ans:** “Magnification is the increase in the apparent size of an object”.

- It is an important factor in microscopy.

**Example:**

A light microscope can magnify objects only upto 1500 times without causing blurriness. Its magnification is 1500X.

**3. Define Resolving power or Resolution?**

(SGD 2015, RWP 2015)

**Ans:** “Resolving power or resolution is the measure of the clarity of an image”.

OR

“It is the minimum distance at which two objects can be seen as separate objects”.

**Example:**

Human naked eye can differentiate between two points which are at least 0.1 mm apart. This is known as the resolution of human eye.

**4. Describe the working of light Microscope.**

Text Book page#53 (GRW 2013)

**Ans: Working:**

A light microscope works by passing visible light through a specimen. It consists of two glass lenses.

One lens produces an enlarged image of the specimen and the second lens magnifies the image and projects it into the viewer's eye or onto photographic film.

**5. What do you understand by “LM 109X” written on the edge of Micrograph?**

**Ans:** It tells us that the photomicrograph was taken through a light microscope and image has been magnified 109 times.

**6. Compare the magnification and resolving power of Light and Electron Microscope?**

**Ans:**

Light microscope

Electron microscope



<ul style="list-style-type: none"> <li>• Magnification of light microscope is 1500X.</li> <li>• The resolving power of light microscope is 0.2 micrometer. (<math>\mu\text{m}</math>)</li> </ul>	<ul style="list-style-type: none"> <li>• Magnification of electron microscope is 250,000 X.</li> <li>• The resolving power of electron microscopes is 0.2 nanometer. (nm)</li> </ul>
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**7. Describe the working of Electron Microscope? Text Book page#54 (BWP 2015)**

**Ans: Working:**

In electron microscope, the object and the lens are placed in a vacuum chamber and a beam of electrons is passed through the object. Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or a photographic film.

**8. What problem is faced by Scientists using Electron Microscope?**

**Ans:** Electron microscope cannot be used to study life processes, because the specimen must be held in a vacuum chamber i.e. all air must be removed.

**9. What is difference between SEM and TEM? Text Book page#55 (DGK 2014)**

**Ans:**

SCANNING ELECTRON MICROSCOPE	TRANSMISSION ELECTRON MICROSCOPE
<ul style="list-style-type: none"> <li>• In SEM, electrons are reflected from the metal coated surfaces.</li> <li>• It is used to study the structure of cell surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>• In TEM, electrons are transmitted through the specimen.</li> <li>• It is used to study the internal cell structure.</li> </ul>

**10. What is the contribution of Robert Hook in formulation of cell theory?**

**Ans:** Cells were first described by a British scientist, Robert Hooke in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a 'honeycomb' of tiny empty compartments. He called those compartments in the cork as 'cellulae'. His term has come to us as cells.

**11. Discuss the role of Schleiden and Schwann in development of cell theory?**

**Text Book page#56**

**Ans: Role of Matthias Schleiden:**

In 1838, a German botanist Matthias Schleiden studied plant tissues and made the first statement of Cell Theory. He stated that:

'All plants are aggregates of individual cells which are fully independent'.

**Role of Theodor Schwann:**

One year later, in 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells.

**12. State postulates of cell theory. (LIIR 2013, 2016, SGD 2015, RWP 2015)**

**Ans: Postulates of Cell Theory:**

Cell theory in its modern form, includes the following principles,

- All organisms are composed of one or more cells.
- Cells are the smallest living things, the basic unit of organization of all organisms.
- Cells arise only by divisions in previously existing cells.

**13. Why sub-cellular or acellular particles are not included in five kingdoms of organism?**

**Ans:** According to the first statement of cell theory, all organisms are composed of one or more cells. The following organisms are sub-cellular or acellular particles and are not composed of cells:

- Viruses
- Prions
- Viroids

**Non-living Characteristic:**

They do not run any metabolism inside them.

**Living Characteristic:**

They show some characteristics of living organisms like:

- They can increase in number.
- They can transmit their characters to the next generations.

**Classification:**

Such acellular particles are not classified in any of the five kingdoms of organisms.

**14. Name the structures in cell that are not organelles.** **Text Book page#57**

**Ans:** Following are the structures in cells that are not called organelles.

- Cell wall
- Cell membrane
- Cytoplasm
- Cytoskeleton

**15. What is difference between primary and secondary cell wall?** **(GRW 2013)**

**Ans:**

PRIMARY WALL	SECONDARY WALL
<ul style="list-style-type: none"><li>• Outer layer of plant cell wall is called as primary wall.</li><li>• Primary wall is composed of cellulose.</li></ul>	<ul style="list-style-type: none"><li>• Some plants have additional wall on the inner side of primary wall called as secondary wall.</li><li>• Secondary wall is composed of lignin.</li></ul>

**16. Define Plasmodesmata.** **(SWL 2014, 2015, BWP 2014)**

**Ans:** "There are pores in the cell walls of adjacent plant cells, through which their cytoplasm is connected. These pores are called plasmodesmata".

**17. What is the role of cell membrane around the cells?** **(DGK 2015)**

**Ans:**

(i) **Semi-permeable Barrier:**

Cell membrane functions as a semi-permeable barrier, allowing a very few molecules across it while fencing a majority of chemicals inside the cell. In this way, it maintains internal composition of cell.

(ii) **Chemical sensor:**

Cell membrane also senses chemical messages and can identify other cells.

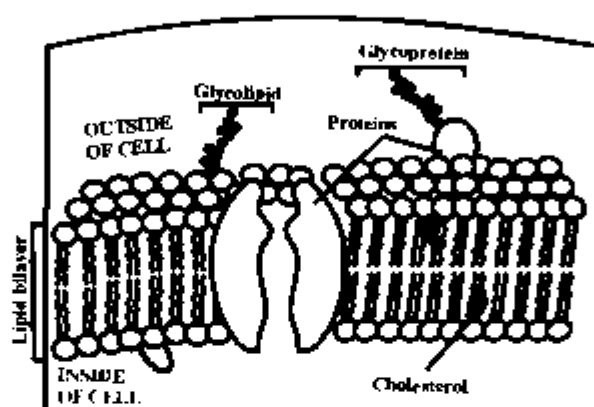
**18. Clarify that plasma membrane and cell membrane are two different terms.**

**Text Book page#59**

**Ans:** When we talk about all the membranes of a cell, we say them as cell membranes. But when we talk about only the outer membrane of cell, we say it as plasma membrane.

**19. Draw and label the diagram of cell membrane.**

**Ans:**



**Figure: The Fluid-Mosaic Model of Cell Membrane**

**20. Define Fluid Mosaic Model.**

**(BWP 2014, MTN 2015)**

**Ans: Fluid Mosaic Model:**

According to this model, there is a lipid bilayer in which the protein molecules are embedded. The lipid bilayer gives fluidity and elasticity to membrane. Small amounts of carbohydrates are also found in cell membranes.

**21. Define Cytoplasm.**

**Ans: Introduction:**

Cytoplasm is the semi-viscous and semi-transparent substance.

**Location:**

It is present between plasma membrane (cell membrane) and the nuclear envelope.

**Chemical Composition:**

It contains:

- Water
- Many organic molecules (proteins, carbohydrates, lipids)
- Inorganic salts

**22. Write down the functions of cytoplasm.**

**(DGK 2014)**

**Ans:** Following are some important functions of cytoplasm:

- Cytoplasm provides space for the proper functioning of organelles.
- It also acts as the site for various biochemical (Metabolic) reactions.

**Example:**

Glycolysis (break down of glucose during cellular respiration) occurs in cytoplasm.

**23. What is difference between Microtubules and Microfilaments? Text Book page#60**

**Ans:**

<b>MICROTUBULES</b>	<b>MICROFILAMENTS</b>
<ul style="list-style-type: none"> <li>• Microtubules are composed of tubulin protein.</li> <li>• They are used by cells to hold their shape.</li> </ul>	<ul style="list-style-type: none"> <li>• Microfilaments are composed of actin protein.</li> <li>• They help cells to change their shapes.</li> </ul>

**24. Define Organelles.**

**Ans:** “Organelles are small structures within cells that perform dedicated functions. There are about a dozen types of organelles commonly found in eukaryotic cells”.

**Example:**

- Nucleus
- Ribosomes

**25. Define Nucleolus.**

**Ans:** “Nucleolus is a dark spot and it is the site where ribosomal RNA are formed and assembled as ribosomes”.

**26. What do you know about Ribosomes? Book page#61 (LHR 2014, FSD 2014)**

**Ans: Introduction:**

Ribosomes are tiny granular structures.

**Location:**

They are either freely floating in the cytoplasm or are bound to endoplasmic reticulum (ER).

**Chemical Composition:**

Each ribosome is made up of equal amounts of:

- Proteins
- Ribosomal RNA (rRNA)

**27. Write the functions of mitochondria. (SWL 2014)**

**Ans:** Mitochondria are the sites of aerobic respiration, and are the major energy production centers. Therefore, these are also power house of the cell.

**28. What is special about Mitochondria? Text Book page#62**

**Ans:** Mitochondria have their own DNA and Ribosomes. The ribosomes of mitochondria are more similar to bacterial ribosomes than to eukaryotic ribosomes.

**29. Define Chloroplast.****(FSD 2015)****Ans: Structure:**

Chloroplast is also bounded by a double membrane. The outer membrane is smooth.

**Thylakoids:**

The inner membrane gives rise to sacs called 'Thylakoids'. The thylakoids contain chlorophyll (the green pigment necessary for photosynthesis) and associated pigments.

**Function:**

Chloroplasts are the sites of Photosynthesis in eukaryotes. They contain chlorophyll and associated pigments.

**30. Where chromoplast are located? What are their functions? (SWL 2015, DKG 2015)**

**Ans:** The second type of plastids in plant cells are chromoplasts. They contain pigments associated with bright colors and are present in the cells of flower petals and fruits.

**Function:**

Their function is to give colors to these parts and thus help in pollination and dispersal of fruit.

**31. Differentiate between SER and RER. Book page#63 (RWP 2015, SGD 2015)****Ans:**

<b>SMOOTH ENDOPLASMIC RETICULUM</b>	<b>ROUGH ENDOPLASMIC RETICULUM</b>
<ul style="list-style-type: none"><li>• It is smooth in appearance because it lacks ribosomes.</li></ul> <b>Functions:</b> <ul style="list-style-type: none"><li>• It detoxifies the harmful chemicals that have entered cell.</li><li>• It is involved in lipid metabolism.</li><li>• It helps in transport of materials from one part of cell to other.</li></ul>	<ul style="list-style-type: none"><li>• It is rough in appearance due to numerous ribosomes that are attached to it.</li></ul> <b>Function:</b> <ul style="list-style-type: none"><li>• It serves a function in protein synthesis.</li></ul>

**32. What do you know about Camillo Golgi? Discuss his contribution.****Text Book page#64****Ans: Discovery:**

An Italian physician, Camillo Golgi discovered Golgi apparatus and thus they were named after him.

**Nobel Prize:**

In 1906, Golgi was awarded Nobel Prize for physiology and medicine.

**33. What are Lysosomes? Give their functions.****(LHR 2015)****Ans: Discovery:**

In the mid-twentieth century, a Belgian scientist Christian Rene de Duve discovered lysosomes.

**Structure:**

Lysosomes are single-membrane bound organelles.

**Function:**

They contain strong digestive enzymes and work for the break down (digestion) of food and waste materials within the cell.

**34. Define Centrosome.**

**Text Book page#65 (LIIR 2016)**

**Ans:** "Animal cells have two centrioles located near the exterior surface of nucleus. The two centrioles are collectively called a centrosome."

**Function:**

Their function is to help in the formation of spindle fibers during cell division.

**35. What can happen when a lysosome burst inside the cell and all its enzymes are released in cytoplasm?**

**Ans:** If enzymes of lysosomes are released in cytoplasm then all the protein content of cell may be destroyed resulting in killing of cell.

**36. What is the difference between food vacuole and contractile vacuole?**

**Ans:** Many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes where as some unicellular organisms use contractile vacuole for the elimination of wastes from their bodies.

**37. Draw and label the diagram of Typical Prokaryotic Cell. Text Book page#66**

**Ans:**

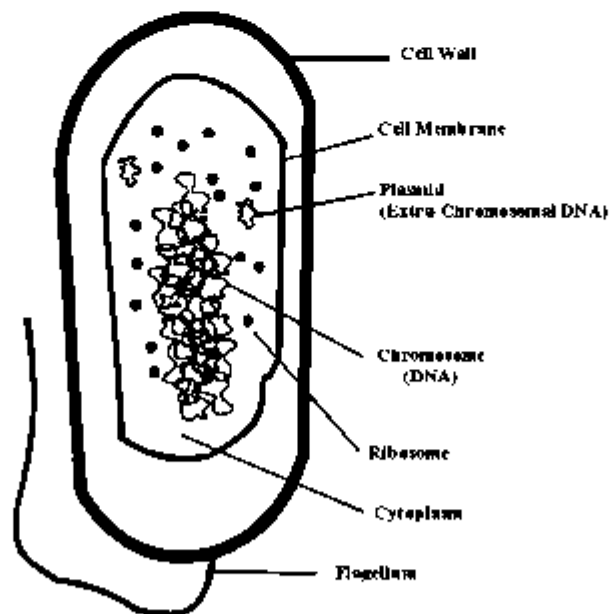


Figure: A General Prokaryotic Cell

**38. State any two differences between prokaryotic and eukaryotic cell. (SGD 2014)**

**Ans:**

PROKARYOTIC CELL	EUKARYOTIC CELL
<ul style="list-style-type: none"> <li>Prokaryotic cells do not have prominent nucleus and do not have nuclear envelope around the nucleus.</li> <li>Cell wall of prokaryotic cell is made of peptidoglycan.</li> </ul>	<ul style="list-style-type: none"> <li>Eukaryotic cells have prominent nucleus bounded by nuclear envelope.</li> <li>Cell wall of eukaryotic cell is made of cellulose (in plants) or chitin (in fungi)</li> </ul>

**39. How size and shape is related to function of cell?**

**Text Book page#67**

**Ans:** Cell size and shape are related to cell function.

- Red blood cells are round to accommodate globular haemoglobin.
- Nerve cells are long for the transmission of nerve-impulses.
- Xylem cells are tube-like and have thick walls for conduction of water and support.
- Bird eggs are bulky because they contain a large amount of nutrient for the developing young.
- Long muscles cells are efficient in pulling different body parts together.

**40. A cell works as an open system. Justify.**

**Ans:** A cell works as an 'open system', i.e. it takes in substances needed for its metabolic activities through its cell membrane. Then it performs the metabolic processes assigned to it. Products and by-products are formed in metabolism. Cell either utilizes the products or transports them to other cells. The by-products are either stored or are excreted out of the cell.

**41. Discuss relationship of cell volume with surface area.**

**Text Book page#68**

**Ans:** Need of nutrients and rate of waste production are directly proportional to cell volume. Cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. But a large cell has a much smaller surface area relative to its volume than smaller cells have.

**Conclusion:**

The membranes of small cells can serve their volumes more easily than the membrane of a large cell.

**42. Differentiate between diffusion and facilitated diffusion.**

**Text Book page#69 (GRW 2014)**

**Ans:**

DIFFUSION	FACILITATED DIFFUSION
<ul style="list-style-type: none"> <li>Movement of molecules from an area of higher concentration to an area of lower concentration is called diffusion.</li> <li>The rate of simple diffusion is less.</li> </ul>	<ul style="list-style-type: none"> <li>When a transport protein moves a substance from higher to lower concentration the process is called facilitated diffusion.</li> <li>The rate of facilitated diffusion is higher than simple diffusion.</li> </ul>

**43. Define Osmosis.****Text Book page#70 (RWP 2015, BWP 2015)**

**Ans:** "The movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration is called osmosis".

- The rules of osmosis are understood by the concept of tonicity of solutions.

**44. What is difference between diffusion and osmosis? (LHR 2013, DGK 2014)**

**Ans:**

<b>DIFFUSION</b>	<b>OSMOSIS</b>
<ul style="list-style-type: none"><li>• Movement of molecules from an area of higher concentration to an area of lower concentration is called diffusion.</li><li>• It refers to movement of molecules in general within cells or across cell membrane along concentration gradient.</li></ul>	<ul style="list-style-type: none"><li>• Osmosis is the movement of water molecules across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.</li><li>• It refers to movement of water molecules in particular within cells or across cell membrane along concentration gradient.</li></ul>

**45. What do you know about TONICITY?****(LHR 2013, 2016, SWL 2015)**

**Ans: Tonicity of Solutions:**

The term tonicity refers to the relative concentration of solutes in the solutions being compared.

**Types of Solutions:**

According to tonicity of solutions, the solutions can be categorized into three types:

**Hypertonic Solution:**

A hypertonic solution has relatively more solute.

**Hypotonic Solution:**

A hypotonic solution has relatively less solute.

**Isotonic Solution:**

An isotonic solution has equal concentrations of solutes.

**46. What will happen if a plant cell is placed in hypotonic solution? Text Book page#71**

**Ans:** Most plant cells live in hypotonic environment, i.e. there is low concentration of solutes in extra-cellular fluids than in cells. As a result, water first tends to move inside cell and then inside vacuole. When vacuole increases in size, cytoplasm presses firmly against the interior of cell wall, which expands a little. Due to the strong cell wall, plant cell wall does not rupture, but instead becomes rigid.

**47. What is turgor?****(GRW 2015, BWP 2015, SGD 2014, 2015)**

**Ans:** "In rigid condition the outward pressure on cell wall of plants exerted by internal water is known as turgor pressure and the phenomenon is turgor."

**48. Define Plasmolysis.****(LHR 2015, GRW 2015, SWL 2014)**



**Ans:** "In a hypertonic environment a plant cell loses water and cytoplasm shrinks. The shrinking of cytoplasm is called Plasmolysis".

**49. What is role of Osmosis in opening and closing of stomata? Text Book page#72**

**Ans: Opening of Stomata:**

During day time, guard cells are making glucose, and so are hypertonic (have a higher concentration of glucose) than their nearby epidermal cells. Water enters them from other cells and they swell. Hence they assume a rigid bowed shape and a pore is created between them.

**Closing of Stomata:**

At night, there is low solute concentration in guard cells, water leaves them and they become flaccid. In this form, both guard cells rest against each other and the opening is closed.

**50. What are the uses of semi-permeable membranes?**

**Ans:** The knowledge of semi-permeable membranes is applied for various purposes.

- Artificially synthesized semi-permeable membranes are used for the separation of bacteria from viruses because bacteria cannot cross a semi permeable membrane
- In advanced water treatment technologies, membrane based filtration systems are used. In this process, semi-permeable membranes separate salts from water (reverse osmosis).

**51. Define reverse osmosis.**

**(LHR 2014)**

**Ans: Reverse Osmosis:**

"The process in which semi-permeable membranes separate salts from water is called reverse osmosis."

**52. Define FILTRATION.**

**Ans:** "A process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure, or blood pressure is called filtration."

**Example:**

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells.

**53. Define Active Transport.**

**Text Book page#73 (LHR 2015, DGK 2014)**

**Ans:** "The movement of molecules from an area of lower concentration to the area of higher concentration, with the expenditure of energy in the form of ATP is called active transport".

**Concentration Gradient:**

In active transport the movement is against the concentration gradient.

**Example:**

Movement of sodium and potassium ions through membranes of nerve cells

**54. Differentiate between Endocytosis and Exocytosis. Text Book page#74 (GRW 2013)**

**Ans:**

ENDOCYTOSIS	EXOCYTOSIS
<ul style="list-style-type: none"> <li>Endocytosis is the process of cellular ingestion of bulky materials by the infolding of cell membrane</li> <li>Some part of cell membrane is lost during endocytosis</li> </ul>	<ul style="list-style-type: none"> <li>Exocytosis is a process through which bulky material is exported out of the cell.</li> <li>This process adds new membrane which replaces the parts of cell membrane during endocytosis</li> </ul>

**55. Differentiate between phagocytosis and pinocytosis.**

(LIIR 2015, MTN 2014, DGK 2015, SGD 2015)

**Ans:**

PHAGOCYTOSIS	PINOCYTOSIS
<ul style="list-style-type: none"> <li>In phagocytosis cell takes in solid material.</li> <li>It is also known as cellular eating.</li> </ul>	<ul style="list-style-type: none"> <li>In pinocytosis cells takes in liquid in the form of droplets.</li> <li>It is also known as cellular drinking.</li> </ul>

**56. Name the Animal tissues with their types.**

Text Book page#75

**Ans:** In the bodies of animals, there are four major categories of tissues.

(i) **Epithelial Tissues:**

Some types of Epithelial tissues include:

- Squamous Epithelium
- Cuboidal Epithelium
- Columnar Epithelium
- Ciliated Columnar Epithelium
- Stratified Squamous Epithelium

(ii) **Connective Tissue:**

Common examples of this tissue are:

- Bone
- Blood
- Adipose Tissue

(iii) **Muscle Tissue**

Some types of muscle tissues are:

- Skeletal muscles
- Smooth muscles
- Cardiac muscles

(iv) **Nervous Tissue**

**57. Define Epithelial Tissues.**

**Ans:** Epithelial tissues covers the outside of body and lines organs and cavities. The cells in this tissue are very closely packed together.

**Types:**

This tissue has many types on the basis of the shape of cells as well as the number of cell layers. Some types includes:

- Squamous Epithelium
- Cuboidal Epithelium

**58. What is the difference between skeletal and smooth muscle?**Text Book page # 77

**Ans:**

<b>SKELETAL MUSCLE</b>	<b>SMOOTH MUSCLE</b>
<ul style="list-style-type: none"> <li>• Skeletal muscles are attached to bones.</li> <li>• Their cells are striated and contain many nuclei.</li> <li>• They are responsible for the movement of bones.</li> <li>• These are voluntary in their action.</li> </ul>	<ul style="list-style-type: none"> <li>• Smooth muscles are found in the walls of alimentary canal, urinary bladder, blood vessels etc.</li> <li>• Their cells are non striated and each with a single nucleus.</li> <li>• They are responsible for the movement of substances.</li> <li>• These are involuntary in their action.</li> </ul>

**59. Name the Plant tissues with their types.**

**Text Book page # 78**

**Ans:** There are two major categories of tissues in plants.

**(i) Simple Tissues**

They are of two types:

**(a) Meristematic tissues.**

It is of further two main types:

- Apical meristems
- Lateral meristems

**(b) Permanent Tissues**

It is of further three types:

- Epidermal tissues
- Ground Tissues
- Support Tissues

**(ii) Compound Tissues**

These tissues are of two types:

- Xylem Tissues
- Phloem Tissues

**60. Differentiate between apical and lateral meristems.**

**(LHR 2015)**

**Ans:**

<b>APICAL MERISTEMS</b>	<b>LATERAL MERISTEMS</b>
<ul style="list-style-type: none"> <li>• They are located at the apices (tips) of roots and shoots.</li> <li>• When they divide, they cause increase in the length of plant. Such growth is called primary growth.</li> </ul>	<ul style="list-style-type: none"> <li>• They are located on the lateral sides of roots and shoots.</li> <li>• By dividing, they are responsible for increase in growth of plant parts. This growth is called secondary growth.</li> </ul>

**61. Define Permanent tissues.**

**Text Book page # 79**

**Ans:** "The cells of the tissues which do not have the ability to divide are called permanent tissues".  
Permanent tissues originate from meristematic tissues.

**Types:**

Permanent tissues are classified into the following types:

- (i) Epidermal Tissues
- (ii) Ground Tissues
- (iii) Support Tissues

**62. What is special about parenchyma cells?**

**Text Book page # 80**

**Ans:** Most parenchyma cells can develop the ability to divide and differentiate into other types of cells and they do so during the process of repairing and injury.

**63. What do you know about Xylem Tissues? Text Book page # 81 (GRW 2012)**

**Ans:** Xylem tissues are the type of compound tissues.

Two types of cells are found in xylem tissue:

- Vessel elements or cells
- Tracheids

**Functions:**

- Xylem tissue is responsible for the transport of water and dissolved substances from roots to the aerial parts.
- It also provides support to the plant body due to the presence of lignin.

**64. What is the role of phloem tissues in plants?**

**(SWL 2015, MTN 2015)**

**Ans:** Phloem tissue is responsible for the conduction of dissolved organic matter (food) between different parts of plant body. Phloem tissue contains sieve tube cells and companion cells.

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## Unit 4: Cells and Tissues

### Multiple Choice Questions

1. The first compound microscope was developed by: Text Book Page # 52 (LHR 2014)  
(a) Robert Hooke (b) Leeuwenhoek  
(c) Zacharias Janssen (d) Aristotle
2. The increase in the apparent size of an object:  
(a) Resolution (b) Microscopy  
(c) Magnification (d) Both a & b
3. The measure of the clarity of an image is called:  
(a) Magnification (b) Resolution  
(c) Microscopy (d) Both a & b
4. The Resolution of human eye: (DGK 2015, MTN 2015, LHR 2016)  
(a) 0.1 mm (b) 0.2 mm  
(c) 0.3 mm (d) 0.4 mm
5. The magnification of a light microscope: Text Book Page # 53  
(a) 1000X (b) 1500X  
(c) 2000X (d) 2500X
6. The resolution of light microscope is:  
(a) 0.1  $\mu\text{m}$ . (b) 0.2  $\mu\text{m}$ .  
(c) 0.3  $\mu\text{m}$ . (d) 0.4  $\mu\text{m}$ .
7. A photograph taken through a microscope:  
(a) Micrograph (b) Photomicrograph  
(c) both a&b (d) None of these
8. The magnification of an electron microscope: Text Book Page # 54 (GRW 2014)  
(a) 100,000X (b) 150,000X  
(c) 200,000X (d) 250,000X
9. The resolution of electron microscope is: (GRW 2014)  
(a) 0.2 nm (b) 0.3 nm  
(c) 0.4 nm (d) 0.5 nm
10. Which type of microscope is better to study the movement of Amoeba?  
(a) Transmission electron microscope (b) Scanning electron microscope  
(c) Light microscope (d) Compound microscope
11. The microscope used to study the changes in the shape of a human white blood cells:  
(a) Light microscope (b) Compound microscope  
(c) Scanning electron microscope (d) Transmission electron microscope
12. Which type of microscope is used to study the surface texture of human hair?  
(a) Light microscope (b) Scanning electron microscope  
(c) Transmission electron microscope (d) Compound microscope
13. The type of microscope used to study the detailed structure of a mitochondria in the cell of human liver:  
(a) Light microscope (b) Scanning electron microscope  
(c) Transmission electron microscope (d) Compound microscope
14. Cells were first described by a British scientist: Text Book Page # 55  
(SGD 2015, RW 2013, LHR 2013, SWL 2014)  
(a) Robert Hooke (b) Leeuwenhoek  
(c) Schleiden (d) Schwann

15. Who discovered nucleus in the cell? Text Book Page # 56  
 (a) Aristotle (RWP 2015, MTN 2015, GRW 2015)  
 (b) Robert Brown  
 (c) Schwann (d) Schleiden
16. Who proposed that all living cells arise from pre-existing cells? (RWP 2014)  
 (a) Robert Brown (b) Rudolf Virchow  
 (c) Louis Pasteur (d) Leeuwenhoek
17. A German botanist who studied plant tissues and made the first statement of cell theory:  
 (a) Robert Hooke (b) Robert Brown  
 (c) Mathias Schleiden (d) Theodor schwann
18. The cell wall of fungi is made up of: Text Book Page # 57 (SWL 2015, GRW 2014)  
 (a) Cellulose (b) Lignin  
 (c) Peptidoglycan (d) Chitin
19. In the cell wall of plants, the chemical present is: (MTN 2014, GRW 2015)  
 (a) Cellulose (b) Chitin  
 (c) Sodium (d) Potassium
20. The cell wall of prokaryotes is made up of: (LHR 2014)  
 (a) Cellulose (b) Lignin  
 (c) Peptidoglycan (d) Chitin
21. Primary wall is made up of:-  
 (a) Cellulose (b) Lignin  
 (c) Chitin (d) All of these
22. Secondary wall is made up of:  
 (a) Cellulose (b) Lignin  
 (c) Chitin (d) Peptidoglycan
23. Cell membrane is mainly composed of: Text Book Page # 59 (DGK 2014, SWL 2014)  
 (a) Proteins (b) Lipids  
 (c) Carbohydrates (d) All of these
24. Which is not present in cell membrane? (DGK 2014)  
 (a) Carbohydrates (b) Proteins  
 (c) Lipids (d) DNA
25. In eukaryotic cells, which of the following organelles are bounded by cell membranes? Text Book Page # 60  
 (a) Mitochondria, chloroplasts (b) Golgi apparatus  
 (c) Endoplasmic reticulum (d) All of these
26. Microtubules are made up of:  
 (a) Tubulin (b) Tropomyosin  
 (c) Myosin (d) Actin
27. Microfilaments are made up of:  
 (a) Tubulin (b) Tropomyosin  
 (c) Myosin (d) Actin
28. Which organelles are involved in protein synthesis? Text Book Page # 61  
(DGK 2015, SWL 2015, LHR 2016)  
 (a) Mitochondria (b) Lysosomes  
 (c) Ribosomes (d) Nucleus
29. Ribosomes are formed in: (MTN 2015, BRW 2014, GRW 2013)  
 (a) Nucleus (b) Nucleolus  
 (c) Cytoplasm (d) Mitochondria
30. Which organelles are involved in energy production? Text Book Page # 62  
(SWL 2014, GRW 2015)  
 (a) Mitochondria (b) Lysosomes

- (c) Ribosomes (d) Nucleus
31. The mitochondrion functions in: (DGK 2014, MTN 2015, BRW 2015, LIIR 2015)
- (a) Lipids storage (b) Photosynthesis  
(c) Protein synthesis (d) Cellular respiration
32. Which of these organelles have their own DNA? Text Book Page # 62  
(SWL 2015, LIIR 2015)
- (a) Lysosomes (b) Mitochondria  
(c) Ribosomes (d) Golgi bodies
33. Plastids are present in the cells of:
- (a) Plants (b) Algae  
(c) Both a and b (d) Fungi
34. Function of Chloroplast is: (BRW 2015)
- (a) Photosynthesis (b) ATP formation  
(c) Protein formation (d) DNA replication
35. The stack of thylakoids is called: (SGD 2014, GRW 2015)
- (a) Cristae (b) Leucoplast  
(c) Granum (d) Stroma
36. Chromoplasts are associated with bright colours and help in:
- (a) Pollination (b) Dispersal of fruits  
(c) Store food (d) Both a and b
37. Leucoplasts are colourless and store (SGD 2014)
- (a) Starch (b) Proteins  
(c) Lipids (d) All of these
38. The type of plastids that contain pigments associated with bright colours:
- (a) Chloroplasts (b) Chromoplasts  
(c) Leucoplasts (d) All of these
39. Smooth endoplasmic Reticulum are involved in: Text Book Page#63
- (a) Lipid metabolism (b) Transport of materials  
(c) Detoxification of harmful chemicals (d) All of these
40. Golgi was awarded Nobel Prize in: Text Book Page#64 (GRW 2014)
- (a) 1905 (b) 1906  
(c) 1907 (d) 1908
41. Flattened sacs, cisternae are found in: (LHR 2012)
- (a) Mitochondria (b) Golgi apparatus  
(c) Ribosomes (d) Plastids
42. Golgi was awarded Nobel Prize for:
- (a) Physiology (b) Medicine  
(c) both a and b (d) Morphology
43. Rene De Duve was awarded Nobel Prize in:
- (a) 1972 (b) 1973  
(c) 1974 (d) 1975
44. Lysosomes were discovered by: (BRW 2015)
- (a) Camillo Golgi (b) Robert Hook  
(c) Christian Rene de Duve (d) A.F.A king
45. Cell organelle which contain digestive enzymes:
- (a) Ribosomes (b) Lysosomes  
(c) Centrioles (d) Endoplasmic Reticulum
46. Animal cells have two centrioles near the exterior surface of nucleus collectively called: Text Book Page # 65
- (a) Centrosome (b) Nucleosome  
(c) Chromosome (d) Both a and b
47. Centrioles are involved in the formation of:



- (a) Spindle fibres (b) Cilia  
(c) Flagella (d) All of these
48. Human body is made up of types of cells: Text Book Page # 67 (SWL 2014)  
(a) 50 (b) 100  
(c) 150 (d) 200
49. The cells that contribute in coordination of the body: Text Book Page#67 (SGD 2015, LHR 2014)  
(a) Nerve (b) Muscle  
(c) RBC (d) Bone cells
50. The cells that undergo contraction and share their role in movements of:  
(a) Nerve (b) Muscle  
(c) Bone (d) All of these
51. The size of smallest Bacterium is: (SGD 2015)  
(a)  $0.4\mu m$  (b)  $0.3\mu m$   
(c)  $0.2\mu m$  (d)  $0.1\mu m$
52. The diameter of human red blood cells is: Text Book Page#68  
(FSD 2014, BRW 2014, LHR 2015)  
(a)  $4\mu m$ . (b)  $6\mu m$ .  
(c)  $8\mu m$ . (d)  $10\mu m$ .
53. Gaseous exchange in gills and lungs occurs by: Text Book Page#69  
(a) Diffusion (b) Facilitated diffusion  
(c) Effusion (d) Osmosis
54. Facilitated diffusion is:  
(a) Active transport (b) Passive transport  
(c) Reverse osmosis (d) All of these
55. Which term refers to the relative concentration of solutes in the solution: Text Book Page#70  
(a) Diffusion (b) Osmosis  
(c) Tonicity (d) Turgor
56. The solution that has relatively more solute: (GRW 2014)  
(a) Hypertonic (b) Hypotonic  
(c) Isotonic (d) All of these
57. The shrinking of cytoplasm is: Text Book Page # 71  
(a) Endocytosis (b) Exocytosis  
(c) Glycolysis (d) Plasmolysis
58. The process in which semi-permeable membranes separate salts from water : Text Book Page#72  
(a) Osmosis (b) Reverse osmosis  
(c) Filtration (d) Diffusion
59. The movement of molecules from a region of lower concentration to higher concentration is called: Text Book Page # 73 (LHR 2015)  
(a) Active transport (b) Osmosis  
(c) Diffusion (d) Filtration
60. Energy is required in: Text Book Page#73  
(a) Osmosis (b) Diffusion  
(c) Filtration (d) Active transport
61. Which one is not an animal tissue?  
(a) Epithelial (b) Connective  
(c) Epidermal (d) Nervous
62. The muscles found in heart: Text Book Page#75  
(a) Skeletal (b) Smooth

63. Cardiac muscles are present in the walls of: (FSD 2014)  
 (a) Heart (b) Lungs  
 (c) Kidney (d) Stomach
64. Blood is an example of: (I.H.R 2012)  
 (a) Epithelial tissue (b) Connective tissue  
 (c) Nervous tissue (d) Muscle tissue
65. Nervous tissues are found in: (DGK 2014)  
 (a) Brain (b) Spinal cord  
 (c) Skin (d) All of these
66. Smooth muscles are formed in the walls of: Text Book Page#77  
 (a) Alimentary canal (b) Urinary bladder  
 (c) Blood vessels (d) All of these
67. Which of these muscles are voluntary in action?  
 (a) Skeletal muscles (b) Smooth muscles  
 (c) Cardiac muscles (d) All of these
68. The muscles that are involuntary in their action are: Text Book Page#77  
 (a) Smooth muscles (b) Cardiac muscles  
 (c) Skeletal muscles (d) Both (a) and (b)
69. The tissues present in lungs, heart and blood vessels are:  
 (a) Squamous epithelium (b) Cuboidal epithelium  
 (c) Stratified squamous epithelium (d) Ciliated columnar epithelium
70. The tissues located at the tips of roots and shoots: Text Book Page#78  
 (a) Apical meristem (b) Lateral meristem  
 (c) Cambium (d) Parenchyma
71. The epidermal tissues contain: Text Book Page#79  
 (a) Root hairs (b) Stomata  
 (c) Both a & b (d) Lenticels
72. Ground tissues are made up of:  
 (a) Collenchyma (b) Sclerenchyma  
 (c) Parenchyma (d) Tracheids
73. The tissues present in the midrib of the leaves and in petals of flowers: Text Book Page#80  
 (a) Collenchyma (b) Sclerenchyma  
 (c) Parenchyma (d) Cambium
74. The function of ground tissues is:  
 (a) Food storage (b) Photosynthesis  
 (c) Respiration and Protein synthesis (d) All of these
75. The cell walls of sclerenchyma tissues are hardened with: Text Book Page#81  
 (a) Chitin (b) Cellulose  
 (c) Peptidoglycan (d) Lignin
76. A plant tissue composed of more than one type of cells:  
 (a) Compound (b) Support  
 (c) Meristematic (d) Ground
77. Transport of water and soluble materials from roots to the aerial parts is done by: (I.H.R 2013)  
 (a) Phloem tissue (b) Xylem tissues  
 (c) Stomal tissues (d) Both (a) and (b)
78. Tracheids are present in:  
 (a) Xylem (b) Phloem  
 (c) Epidermal tissue (d) Parenchyma

79. Phloem tissues contain \_\_\_\_\_ cells:

(GRW 2012)

(a) Tracheids cells

(b) Vessel cells

(c) Fiber cells

(d) Sieve tube cells

80. Companion cells are present in:

Text Book Page#82

(a) Xylem

(b) Phloem

(c) Epidermal tissues

(d) Parenchyma tissues

**ANSWERS KEY**

1	c	11	a	21	a	31	d	41	b	51	d	61	c	71	c
2	c	12	b	22	b	32	b	42	c	52	c	62	c	72	c
3	b	13	c	23	d	33	a	43	c	53	a	63	a	73	a
4	a	14	a	24	d	34	a	44	c	54	b	64	b	74	d
5	b	15	b	25	d	35	c	45	b	55	c	65	d	75	d
6	b	16	b	26	a	36	d	46	a	56	a	66	d	76	a
7	c	17	c	27	d	37	d	47	d	57	d	67	a	77	b
8	d	18	d	28	c	38	b	48	d	58	b	68	d	78	a
9	a	19	a	29	b	39	d	49	a	59	a	69	a	79	d
10	c	20	c	30	a	40	b	50	b	60	d	70	a	80	b

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## Unit 4: Cells and Tissues

### Long Questions

**Q.1** Write a note on light microscope.

Text Book page # 53

**Ans:** LIGHT MICROSCOPE

**Working:**

A light microscope works by passing visible light through a specimen. It consists of two glass lenses.

One lens produces an enlarged image of the specimen and the second lens magnifies the image and projects it into the viewer's eye or onto photographic film.

**Micrograph:**

A photograph taken through a microscope is called a micrograph.

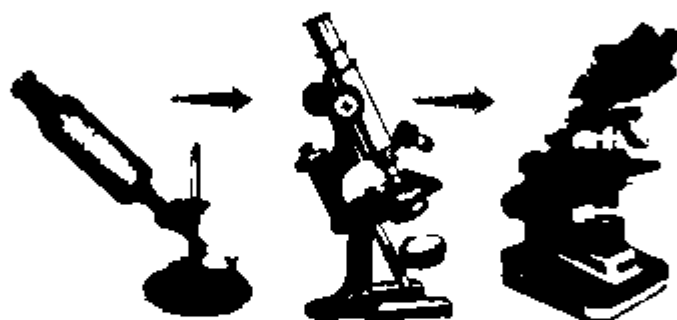


Figure: Light Microscopes: From earlier (left) to the latest (right)

**Magnification:**

A light microscope can magnify objects only 1500 times without causing blurriness. Its magnification is 1500X.

**Resolution or Resolving Power:**

Resolution of a light microscope is 0.2 micrometer ( $\mu\text{m}$ ).

$$(1 \mu\text{m} = 1/1000 \text{ nm})$$

In other words, light microscope can not resolve objects smaller than 0.2  $\mu\text{m}$ . It is about the size of the smallest bacterium.

The image of a bacterium can be magnified many times, but light microscope cannot show the details of its internal structure.



Figure: Light Microscopes view; Amoebae (left), Unicellular algae (right)

**Q.2 Write a note on Electron Microscope.**

**Text Book page # 54**

**Ans: ELECTRON MICROSCOPE**

**Introduction:**

It is the most advanced form of microscope.

**Working:**

In electron microscope, the object and the lens are placed in a vacuum chamber and a beam of electrons is passed through the object. Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or a photographic film.

**Resolution:**

Electron microscope has much higher resolving power than light microscope. The most modern electron microscope can distinguish objects as small as 0.2 nanometer where,

$$1 \text{ nm} = 1/1000,000 \text{ mm.}$$

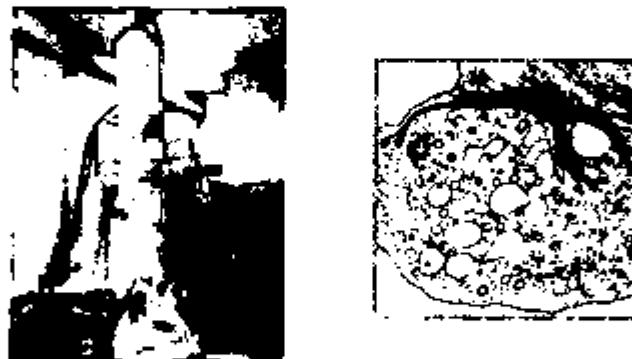
It is a thousand-fold improvement over the light microscope.

**Magnification:**

Electron microscope can magnify objects about 250,000 times.

**Detection in Special Conditions:**

Under special conditions, electron microscope can detect individual atoms. Cells, organelles, and even molecules like DNA and protein are much larger than single atoms.



**Figure: TEM (left) and view of an animal cell (right) through it**

**Types of Electron Microscope:**

There are two types of electron microscope:

**1. Transmission Electron Microscope (TEM):**

In TEM, electrons are transmitted through the specimen.

**Usage:**

TEM is used to study the internal cell structure.

**2. Scanning Electron Microscope (SEM):**

In SEM, electrons are reflected from the metal coated surfaces.

**Usage:**

SEM is used to study the structure of cell surfaces.



**Figure: SEM (left) and view of mosquito's head and eye (right) through it**

**Q.3 Describe the history of formulation of cell theory.**

**Text Book page # 56**

**Ans:**

### **HISTORY**

#### **Role of Aristotle:**

In the history of Biology, ancient Greeks were the first who organized the data of natural world.

Aristotle presented the idea that all animals and plants are somehow related.

#### **Role of Robert Hooke:**

Cells were first described by a British scientist, Robert Hooke in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a 'honeycomb' of tiny empty compartments. He called those compartments in the cork as 'cellulae'. His term has come to us as cells.



**Figure: Robert Hooke was a Chemist, Mathematician and Physicist**

#### **Role of Leeuwenhoek:**

The first living cells were observed a few years later by Dutch naturalist Antonie van Leeuwenhoek. He observed tiny organisms from pond water under his microscope and called them 'animalcules'.

#### **Role of Jean Baptist de-Lamarek:**

In 1809, Jean Baptist de-Lamarek proposed that:

'No body can have life if its parts are not cellular tissues or are not formed by cellular tissues'.

#### **Role of Robert Brown:**

In 1831, a British botanist Robert Brown discovered nucleus in the cell.

#### **Role of Matthias Schleiden:**

In 1838, a German botanist Matthias Schleiden studied plant tissues and made the first statement of Cell Theory. He stated that:

'All plants are aggregates of individual cells which are fully independent'.

#### **Role of Theodor Schwann:**

One year later, in 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells.

#### **Role of Rudolf Virchow:**

In 1855, Rudolf Virchow, a German physician, proposed an important extension of cell theory. He proposed that, 'all living cells arise from pre-existing cells (Omnis cellula e cellula)'.

#### **Role of Louis Pasteur:**

In 1862, Louis Pasteur provided experimental proof of Virchow's idea.

#### **Postulates of Cell Theory:**

Cell theory in its modern form, includes the following principles,

- All organisms are composed of one or more cells.
- Cells are the smallest living things, the basic unit of organization of all organisms.
- Cells arise only by divisions in previously existing cells.



M. Schleiden

T. Schwann

R. Virchow

Figure: Three great German biologists

**Q.4** Write a note on sub-cellular or acellular particles.

Text Book page # 56

**Ans:**

**SUB-CELLULAR OR ACELLULAR PARTICLES**

According to the first statement of cell theory, all organisms are composed of one or more cells. The following organisms are sub-cellular or acellular particles and are not composed of cells:

- Viruses
- Prions
- Viroids

**Non-living Characteristic:**

They do not run any metabolism inside them.

**Living Characteristic:**

They show some characteristics of living organisms like:

- They can increase in number.
- They can transmit their characters to the next generations.

**Classification:**

Such acellular particles are not classified in any of the five kingdoms of organisms.

**Q.5** Devise a key table of scientist who helped in formulation of cell theory?

**Ans:**

SCIENTIST	CONTRIBUTION	YEAR
Zacharias Janssen	Invented Microscope	1590
Robert Hooke	Discovered Cell	1665
A.V Leeuwenhoek	Observed Microorganisms	1674
J.B Lamarck	Proposed the importance of tissues	1809
Robert Brown	Discovered nucleus	1831
M. Schleiden	Studied plant tissues	1838
T. Schwann	Studied animal tissues	1839
R. Virchow	Proposed "omnis cellula e cellula"	1855
L. Pasteur	Proved Virchow's idea	1862



**Q.6 Describe structure and function of cell wall in detail.**

**Ans: CELL WALL**

**Introduction:**

It is found in plants, plant-like protists, and fungi. It is absent in animals and many animal-like protists.

Cell wall is a non-living and strong component of cell.

It is located outside plasma membrane.

**Functions:**

Cell wall provides:

- Strength
- Shape
- Protection
- Support

Plants cells have a variety of chemicals in their cell walls.

**1. Primary Wall:**

The outer layer of plant cell wall is known as the primary wall. Cellulose is the most common chemical in it.

**2. Secondary Wall:**

Some plant cells, have secondary walls on the inner side of primary wall. It is much thicker and contains lignin and some other chemicals.

**Example:**

Xylem cells.

**Plasmodesmata:**

There are pores in the cell walls of adjacent cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

**Chemical composition of cell wall:**

Fungi and many protists have cell walls although they do not contain cellulose. Their cell walls are made of a variety of chemicals.

**Fungi:**

Chitin is present in the cell wall of fungi.

**Prokaryotes:**

Prokaryotes have a cell wall composed of peptidoglycan that is a complex of amino acids and sugars.

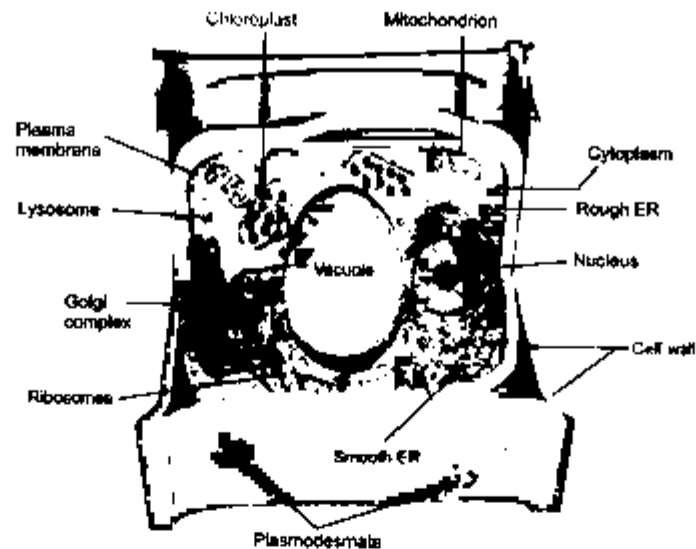


Figure: The Ultra-Structure of a plant cell

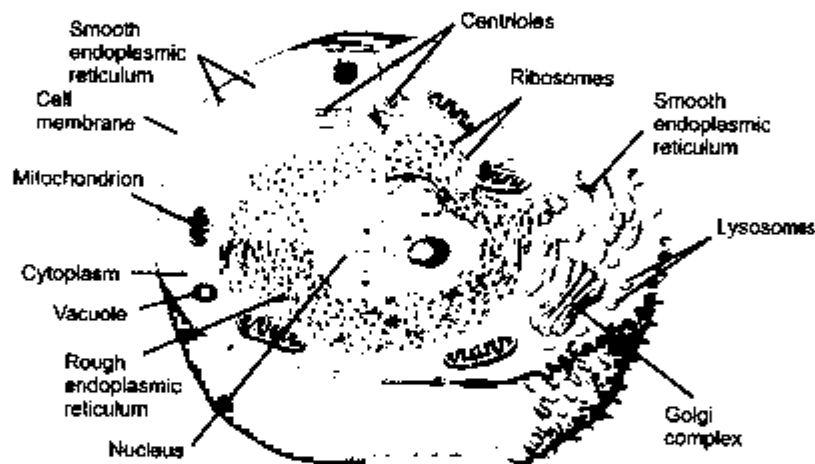


Figure: The Ultra-Structure of a an Animal cell

**Q.7** What do you know about cell membrane? Also discuss fluid mosaic model.

Text Book page # 57+59

**Ans:**

### CELL MEMBRANE

#### **Introduction:**

All prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm.

#### **Location:**

It is the outer most boundary of animal cell and in plants, it is present after the cell wall.

#### **Semi-permeable Barrier:**

Cell membrane functions as a semi-permeable barrier, allowing a very few molecules across it while fencing a majority of chemicals inside the cell. In this way, it maintains internal composition of cell.

#### **Chemical sensor:**

Cell membrane also senses chemical messages and can identify other cells.

**Chemical Composition:**

Chemical analysis reveals that cell membrane is mainly composed of the following:

- Proteins
- Lipids
- Small quantities of carbohydrates

**Structure:**

Electron microscopic examinations of cell membranes have led to the development of a Fluid Mosaic Model of cell membrane.

**Fluid-Mosaic Model:**

According to this model:

- There is a lipid bi-layer in which proteins are embedded.
- The lipid bi-layer gives fluidity and elasticity to the membrane.
- Small amounts of carbohydrates are also found in cell membranes. These are joined with proteins or lipids of the membrane.
- In eukaryotic cells, cholesterol is present in the lipid bi-layer.

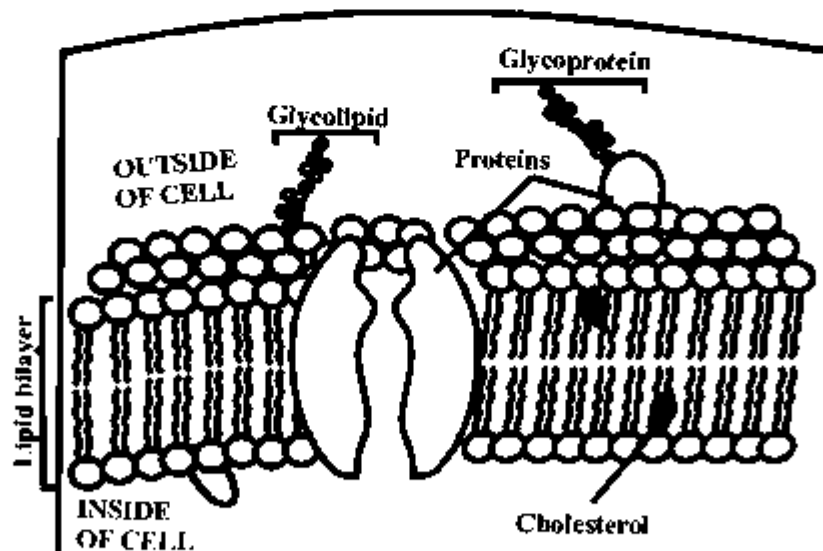
**Membrane-Bounded Organelles:**

In eukaryotic cells many organelles are bounded by cell membranes:

- Mitochondria
- Chloroplasts
- Golgi apparatus
- Endoplasmic reticulum

**Plasma and cell membrane:**

When we talk about all the membranes of a cell, we call them as cell membranes. When we talk about only the outer membrane of the cell, we refer to it as Plasma membrane.



**Figure: The Fluid-Mosaic Model of Cell Membrane**

**Q.8 Write a note on cytoplasm.**

**Ans:**

### **CYTOPLASM**

**Introduction:**

Cytoplasm is the semi-viscous and semi-transparent substance.

**Location:**

It is present between plasma membrane (cell membrane) and the nuclear envelope.

**Chemical Composition:**

It contains many dissolved substances:

- Water
- Many organic molecules (proteins, carbohydrates, lipids)
- Inorganic salts

**Function:**

Cytoplasm has the following important functions:

- It provides space for the proper functioning of the organelles.
- It is a site for many biochemical (metabolic) reactions.

**Example:**

Glycolysis (breakdown of glucose during cellular respiration) occurs in cytoplasm.

**Q.9 Write a note on cytoskeleton.**

**Ans:**

### **CYTOSKELETON**

**Introduction:**

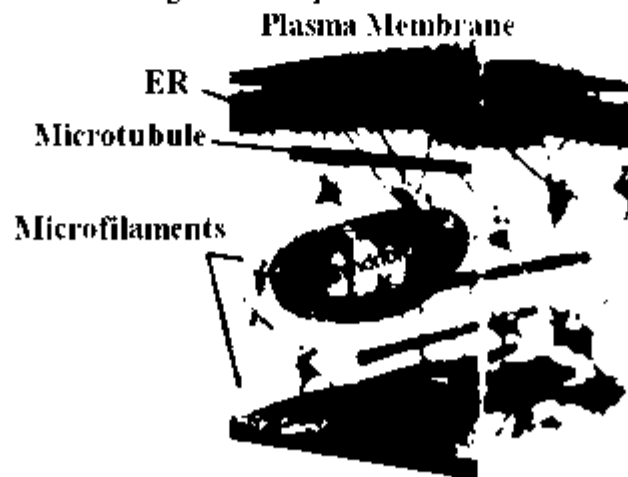
Cytoskeleton is a network of microfilaments and microtubules.

**Microtubules:**

- Microtubules are made up of tubulin protein.
- These help cells to hold their shape.
- They are the major components of cilia and flagella.

**Microfilaments:**

- Microfilaments are thinner and are made up of actin protein.
- They help cells to change their shapes.



**Figure: Cytoskeleton**

**Q.10 Describe structure and function of nucleus with help of labeled diagram.**

Text Book page # 60 (LHR 2013)

**Ans:**

### **NUCLEUS**

**Presence:**

A prominent nucleus occurs in eukaryotic cells.

**Location:**

- In animal cells, it is located in the center.
- In mature plant cells, due to the formation of a large central vacuole, it is pushed to the side.

**Nuclear Envelope:**

Nucleus is bounded by a double membrane known as Nuclear Envelope. Nuclear envelope contains many small pores that enable it to act as a semi permeable membrane.

**Nucleoplasm:**

Inside the nuclear envelope, a granular fluid, nucleoplasm is present. Nucleoplasm contains one or two nucleoli (singular: nucleolus) and chromosomes.

**Nucleolus:**

Nucleolus is a dark spot and it is the site where ribosomal RNA are formed and assembled as ribosomes.

**Chromatin:**

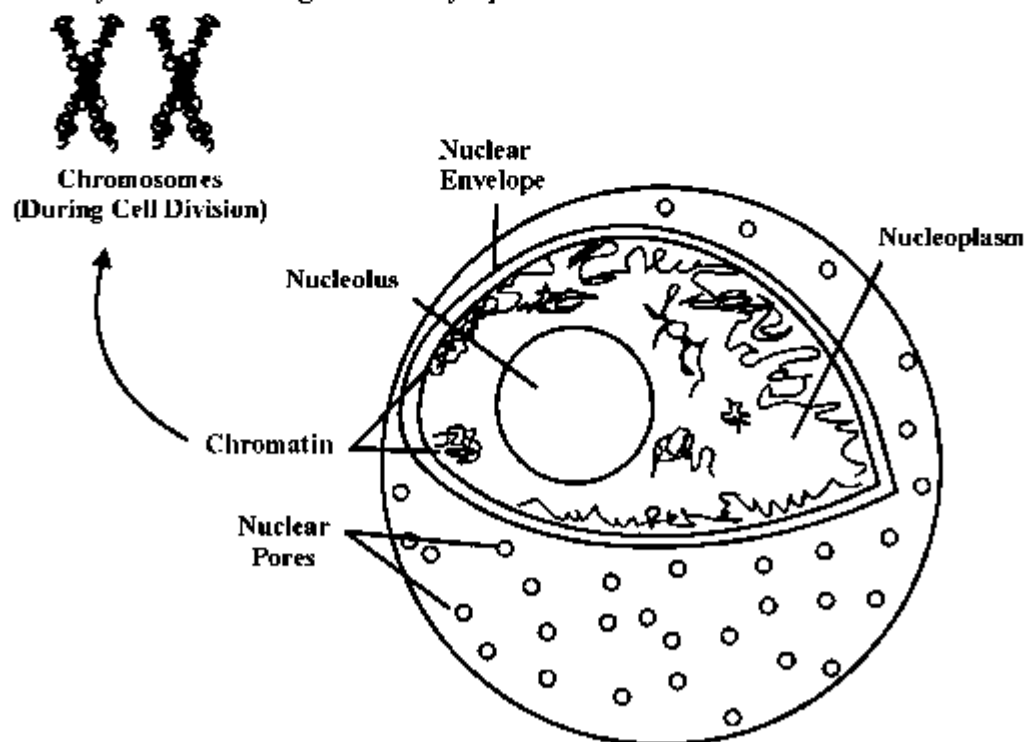
Chromosomes are visible only during cell-division. During interphase, (non-dividing phase), they are in the form of fine thread-like structures called chromatin.

**Chromosomes:**

Chromosomes are composed of Deoxyribonucleic acid (DNA) and proteins.

**Prokaryotic Cells:**

The prokaryotic cells do not contain prominent nucleus. Their chromosome is made up of DNA only and is submerged in the cytoplasm.



**Figure: Structure of Nucleus**

**Q.11 Write a note on ribosomes.**

**Text Book page # 61**

**Ans:**

### **RIBOSOMES**

**Introduction:**

Ribosomes are tiny granular structures.

**Location:**

They are either freely floating in the cytoplasm or are bound to endoplasmic reticulum (ER).

**Chemical Composition:**

Each ribosome is made up of equal amounts of:

- Proteins
- Ribosomal RNA (rRNA)

**Non-membranous:**

Ribosomes are not bound by membranes and are so found in prokaryotes.

**Size:**

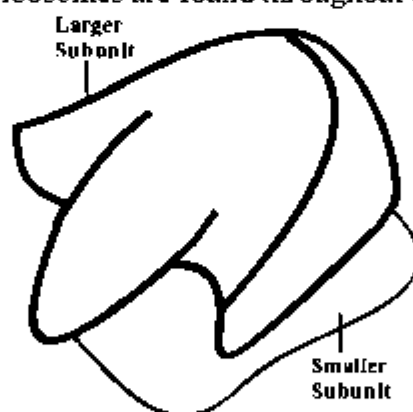
Eukaryotic ribosomes are larger than prokaryotic ribosomes.

**Structure:**

Ribosomes are composed of a larger sub-unit and a smaller sub-unit. When a ribosome is not working, it disassembles into its sub-units.

**Function:**

Ribosomes are the sites of protein synthesis. Protein synthesis is extremely important to cells, and so large numbers of ribosomes are found throughout cells.



**Figure: Ribosome**

**Q.12 Write a note on mitochondria.**

**Text Book page # 62**

**Ans:**

### **MITOCHONDRIA**

**Introduction:**

Mitochondria are double membrane-bounded structures found only in eukaryotic cells only.

**Singular:**

The singular of mitochondria is mitochondrion.

**Function:**

These are the sites of aerobic respiration and are the major energy production centres.

**Structure:**

- The outer membrane is smooth.
- The inner membrane forms many infoldings called cristae (singular: crista) in the inner mitochondrial matrix. This serves to increase the surface area on which membrane-bound reactions can take place.

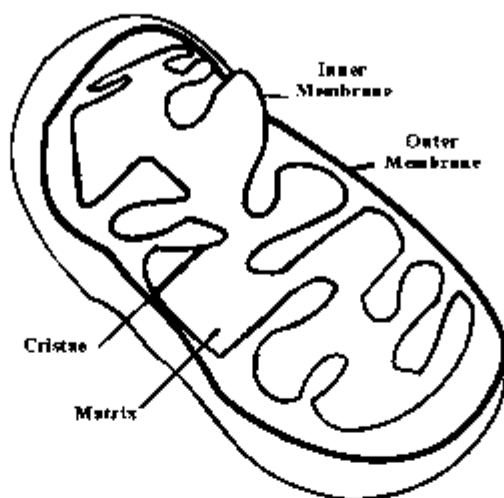


Figure: Mitochondrion

#### DNA and Ribosomes:

Mitochondria have their own DNA and Ribosomes. The ribosomes of mitochondria are more similar to bacterial ribosomes than to eukaryotic ribosomes.

**Q.13** Briefly describe different types of plastids.

(GRW 2012)

**Ans:** **PLASTIDS**

#### Introduction:

Plastids are membrane-bound organelles that only occur in the cells of plants and photosynthetic protists (algae).

#### Types:

Plastids are of three types:

#### 1. Chloroplasts:

Like mitochondria, chloroplast is also bound by a double membrane. The outer membrane is smooth.

#### Thylakoids:

The inner membrane gives rise to sacs called 'Thylakoids'.

#### Granum:

The stack of thylakoids is called 'Granum'. (Plural: grana)

#### Stroma:

The grana float in the inner fluid of chloroplast, which is called 'Stroma'.

#### Function:

Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll (the green pigment necessary for photosynthesis) and associated pigments. These pigments are present in the thylakoids of grana.

#### 2. Chromoplasts:

The second type of plastids in plant cells are chromoplasts.

They contain pigments associated with bright colors.  
They are present in the cells of flower petals and fruits.

**Function**

- Their function is to give colors to petals and fruits and thus help in pollination and dispersal of fruit.

**3. Leucoplasts:**

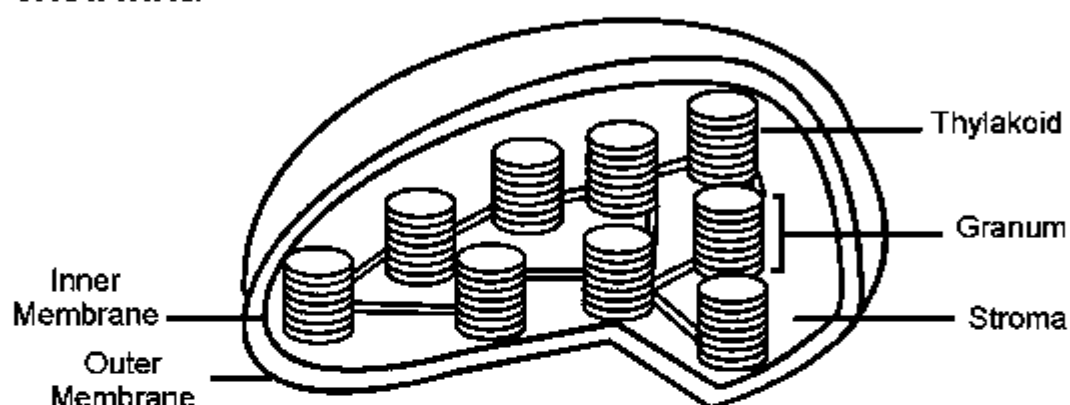
Leucoplasts are the third type of plastids.

**Colour:**

They are colourless.

**Function:**

- They store starch, proteins and lipids. They are present in the cells of those parts where food is stored.



**Figure: Chloroplast**

**Q.14 Write a note on endoplasmic reticulum. Text Book page # 63 (LHR 2013)**

**Ans:** **ENDOPLASMIC RETICULUM**

**Introduction:**

Endoplasmic Reticulum is a network of inter-connected channels that extends from cell membrane to nuclear envelope.

**Types of Endoplasmic Reticulum:**

The network exists in two forms:

**1. Rough Endoplasmic Reticulum (RER):**

It is named so because of rough appearance due to numerous ribosomes that are attached to it.

**Function:**

Due to the presence of ribosomes, RER serves a function in protein synthesis.

**2. Smooth Endoplasmic Reticulum (SER):**

SER lacks ribosomes.

**Functions:**

It is involved in:

- Lipid metabolism
- Transport of materials from one part of cell to other.
- Detoxification of harmful chemicals that have entered the cell.





Figure: Smooth and rough Endoplasmic Reticulum

Q.15 Write a note on Golgi Apparatus?

Text Book page # 64

Ans: GOLGI APPARATUS

**Discovery:**

An Italian physician, Camillo Golgi discovered a set of flattened sacs (cisternae) in cell and thus they were named after him. In 1906, Golgi was awarded Nobel Prize for physiology and medicine.

**Structure:**

In this set, many cisternae are stacked over each other. The complete set of cisternae is called Golgi apparatus or Golgi complex.

It is found in both animal and plant cells.

**Functions**

- It modifies molecules coming from rough endoplasmic reticulum and packs them into small membrane bound sacs called 'Golgi vesicles'.

These sacs can be transported to various location within the cell or to its exterior, in the form of secretions.



Camillo Golgi

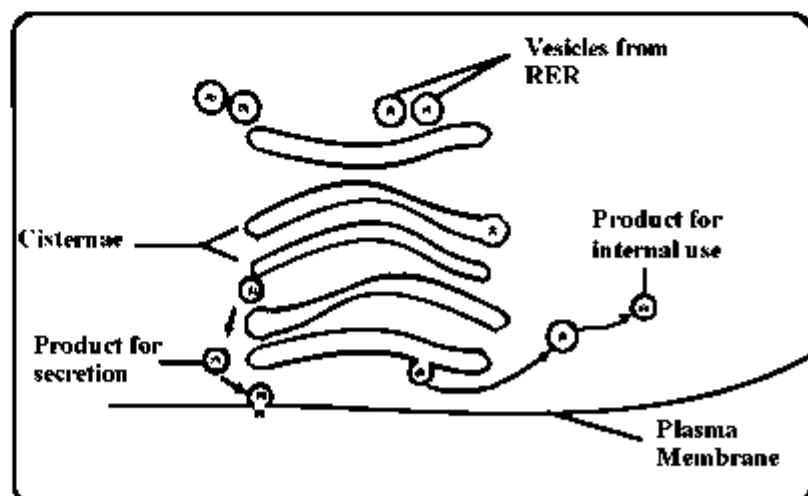


Figure: Functioning of the Golgi Apparatus

**Q.16 Write a note on lysosomes.**

Text Book page # 65

(I.H.R 2013)

**Ans:**

### **LYSOSOMES**

#### **Discovery:**

In the mid-twentieth century, a Belgian scientist Christian Rene de Duve discovered lysosomes. De Duve won the 1974 Nobel Prize for physiology and medicine.

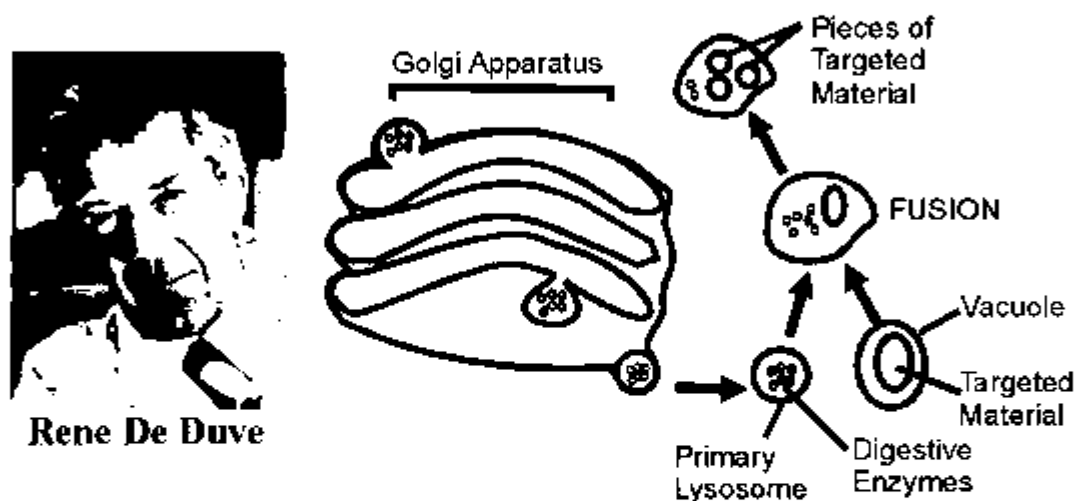
#### **Structure:**

Lysosomes are single-membrane bound organelles.

#### **Function:**

They contain strong digestive enzymes and work for the break down (digestion) of food and waste materials within the cell.

During its function, a lysosome fuses with the vacuole that contains the targeted material and its enzymes break down the material.



**Figure: Formation and Function of Lysosome**

**Q.17 Write a note on centrioles.**

**Ans:**

### **CENTRIOLES**

#### **Introduction:**

Animals and many unicellular organisms have hollow and cylindrical organelles known as Centrioles.

#### **Structure:**

- Each centriole is made up of nine triplets of microtubules.
- They are made up of tubulin protein.

#### **Centrosome:**

Animal cells have two centrioles located near the exterior surface of nucleus. The two centrioles are collectively called Centrosome.

#### **Function:**

- Their function is to help in the formation of spindle-fibers during cell division.
- In some cells, they are also involved in the formation of cilia and flagella.

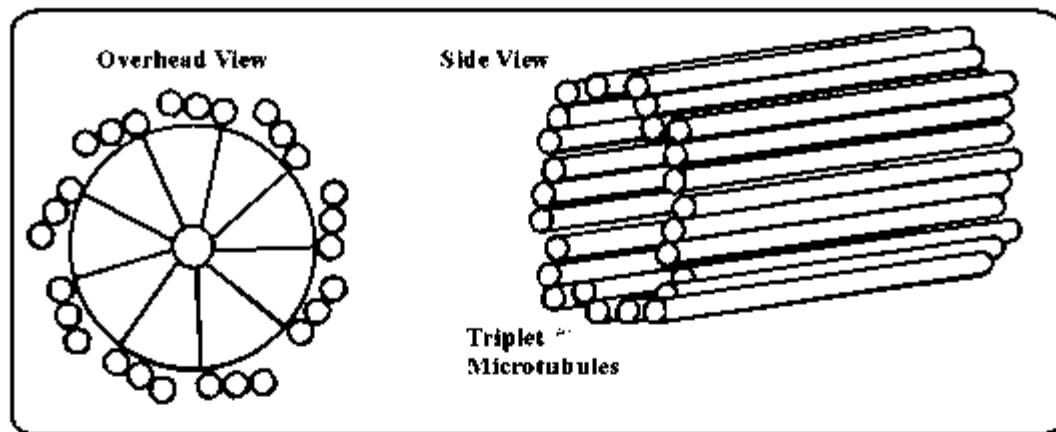


Figure: A Centriole

**Q.18** Write a note on vacuoles.

**Ans:**

### VACUOLES

#### **Introduction:**

Vacuoles are fluid-filled single-membrane bounded organelles. Cells have many small vacuoles in their cytoplasm.

#### **Plant Cells:**

When a plant cell matures, its small vacuoles absorb water and fuse to form a single large vacuole in center. The cell in this state becomes turgid.

#### **Food Vacuole:**

Many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes.

#### **Contractile Vacuole:**

Some unicellular organisms use contractile vacuole for the elimination of wastes from their bodies.

**Q.19** Differentiate between Eukaryotic and Prokaryotic Cells. Text Book page # 66

(LHR 2012, 2013), (GRW 2012)

**Ans:**

### DIFFERENTIATION

Prokaryotes possess prokaryotic cells which are much simpler than eukaryotic cells. The main differences between the two are as follows:

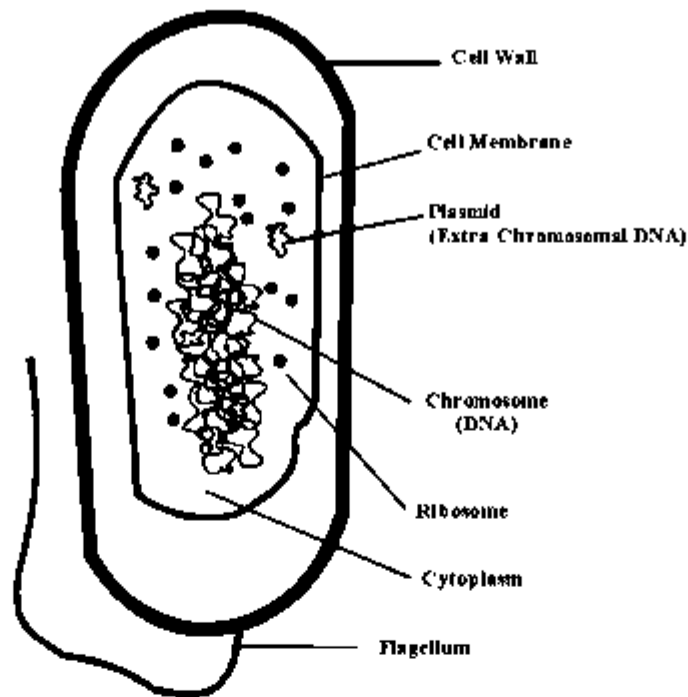


Figure: A General Prokaryotic Cell

EUKARYOTIC CELL	PROKARYOTIC CELL
<p><b>Nucleus</b> Eukaryotic cells have prominent nucleus (bounded by Nuclear envelope)</p>	<p><b>Nucleus</b> Prokaryotic cells do not have prominent nucleus. Their chromosome consists of DNA only and it floats in cytoplasm near centre. This region is called nucleoid.</p>
<p><b>Organelles</b> Membrane-bounded organelles like mitochondria, ER, Golgi apparatus are present</p>	<p><b>Organelles</b> Membrane-bounded organelles like mitochondria, ER, Golgi apparatus are absent</p>
<p><b>Ribosomes</b> Ribosomes are larger in size.</p>	<p><b>Ribosomes</b> Ribosomes are smaller in size.</p>
<p><b>Size</b> Eukaryotic cells are on average 10 times larger than prokaryotic cells</p>	<p><b>Size</b> Prokaryotic cells are 10 times smaller than eukaryotic cells</p>
<p><b>Cell Wall</b> Cell wall is made up of cellulose in plants and chitin in fungi</p>	<p><b>Cell Wall</b> Cell wall is made up of Peptidoglycan (a large polymer of amino acids and sugars)</p>

**Q.20 Describe relationship between cell function and cell structure. Text Book page # 67**

**Ans:**

**RELATIONSHIP**

The bodies of animals and plants are made up of different cell types. Each type performs specific function and all coordinated functions perform the life processes of organism.

**Types of Cells:**

Human body is made up of about 200 types of cells. Cells of one type may differ from those of other types in the following respects:

**Size and Shape:**

- Red blood cells are round to accommodate globular haemoglobin
- Nerve cells are long for the transmission of nerve-impulses.
- Xylem cells are tube-like and have thick walls for conduction of water and support.

**Surface-Area to Volume Ratio:**

- Root hair cells have large surface area for maximum absorption of water and salts.

**Presence or absence of organelles:**

- Cells involved in making secretions have more complex ER and Golgi apparatus.
- Cells involved in photosynthesis have chloroplasts.

**Functions of cells:**

Individual cells contribute to the functioning of the whole body. It can be explained by the following examples of human body cells:

**Nerve Cells:**

Nerve cells conduct nerve impulses and thus contribute to the coordination in body.

**Muscle Cells:**

Muscle cells undergo contraction and share their role in movements in body.

**Red Blood Cells:**

Red blood cells carry oxygen and so contribute in the role of blood in transportation.

**White Blood Cells:**

White blood cells kill foreign agents and so contribute in the role of blood in defence.

**Skin Cells:**

Some skin cells act as physical barriers against foreign materials and some act as receptors for temperature, touch and pain.

**Bone Cells:**

The cells of bone deposit calcium in their extracellular spaces to make the bone tough and thus contribute to the supporting role of bones.

**Cells as an Open System:**

A cell works as an 'open system', i.e. it takes in substances needed for its metabolic activities through its cell membrane. Then it performs the metabolic processes assigned to it. Products and by-products are formed in metabolism. Cell either utilizes the products or transports them to other cells. The by-products are either stored or are excreted out of the cell.

**Q.21** Write a note on cell size and surface area to volume ratio. **Text Book page # 68**

**Ans:** **CELL SIZE AND SURFACE AREA TO VOLUME RATIO**

**Variation in Size:**

Cells vary greatly in size. Most cells lie in between these extremes.

**The Smallest Cell:**

The smallest cells are bacteria called 'Mycoplasmas' with diameter between  $0.1\ \mu\text{m}$  to  $1.0\ \mu\text{m}$ .

**The Bulkiest Cell:**

The bulkiest cells are bird eggs.

**The Longest Cell:**

The longest cells are some muscle cells and nerve cells.

**Relationship of Size and Shape to Function:**

Cell size and shape are related to cell function.

**Bird's Eggs:**

Bird eggs are bulky because they contain a large amount of nutrients for the developing young.

**Muscle Cells:**

Long muscle cells are efficient in pulling different body parts together.

**Nerve Cells:**

Lengthy nerve cells can transmit messages between different body parts.

**Red Blood Cells:**

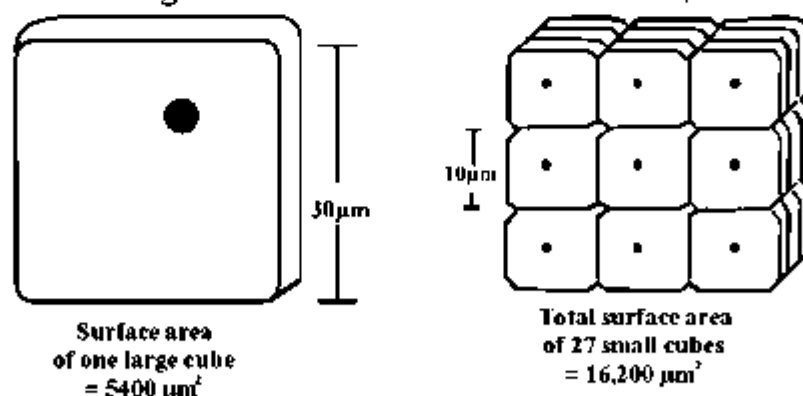
Human red blood cells are only  $8\ \mu\text{m}$  in diameter and therefore can move through our tiniest blood vessels, i.e. capillaries.

**Surface Area of Cells:**

Most cells are small in size. In relation to their volumes, large cells have less surface area as compared to small cells.

**Example:**

The figure shows 1 large cells and 27 small cells. In both cases, total volume is the same.



**Figure: Effect of Cell Size on Surface Area**

**Calculation of Volume:**

$$\text{Volume} = 30\ \mu\text{m} \times 30\ \mu\text{m} \times 30\ \mu\text{m} = 27,000\ \mu\text{m}^3$$

**Calculation of Surface Area:**

In contrast to the total volume, the total surface areas are very different. Because a cubical shape has 6 sides, its surface area is 6 times the area of 1 side. The surface area of cubes is as follows:

$$\text{Surface Area of 1 large cube} = 6 \times (30\ \mu\text{m} \times 30\ \mu\text{m}) = 5400\ \mu\text{m}^2$$

Surface Area of 1 small cube =  $6 \times (10 \mu\text{m} \times 10 \mu\text{m}) = 600 \mu\text{m}^2$

Surface Area of 27 small cubes =  $27 \times 600 \mu\text{m}^2 = 16,200 \mu\text{m}^2$

Need of nutrients and rate of waste production are directly proportional to cell volume. Cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. But a large cell has a much smaller surface area relative to its volume than smaller cells have.

**Conclusion:**

The membranes of small cells can serve their volumes more easily than the membrane of a large cell.

**Q.22** Describe passage of molecules in the and out of cells through diffusion and facilitated diffusion. Text Book page # 69

**Ans:**

**DIFFUSION**

**Definition**

The movement of molecules from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient is called diffusion.

**Explanation:**

The molecules of any substance, (solid, liquid, or gas) are in motion when that substance is above 0 degree Kelvin or -273 degrees Centigrade. In a substance, majority of the molecules move from higher to lower concentration, although there are some that move from low to high.

The overall, or net movement is thus from high to low concentration.

**Equilibrium State:**

Eventually, the molecules reach a state of equilibrium where they are distributed equally throughout the area.

**Importance:**

Diffusion is one principle method of movement of substances within cells, as well as across cell membrane. Carbon dioxide, oxygen, glucose, etc. can cross cell membranes by diffusion.

**Examples:**

- Gas exchange in gills and lungs occurs by diffusion.
- Movement of glucose molecules from the lumen into the blood capillaries of villi.

**Passive Transport:**

A cell does not expend energy when molecules diffuse across its membrane, the diffusion is type of passive transport.

**FACILITATED DIFFUSION**

**Introduction:**

Many molecules do not diffuse freely across cell membranes because of their size or charge. Such molecules are taken into or out of cells with the help of transport proteins present in cell membranes.

**Definition:**

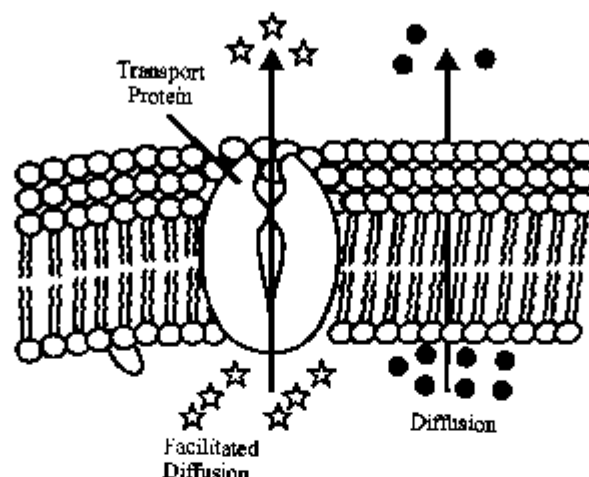
When a transport protein moves a substance from higher to lower concentration, the process is called facilitated diffusion.

**Rate of Diffusion:**

The rate of facilitated diffusion is higher than simple diffusion.

**Passive Transport:**

Facilitated diffusion is a type of passive transport because there is no expenditure of energy in this process.



**Figure: Diffusion and Facilitated Diffusion through Cell Membrane**

**Q.23** Write a note on osmosis and discuss water balance problems. Text Book page # 70+71

**Ans:** **OSMOSIS**

**Definition:**

The movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration is called osmosis.

**Tonicity of Solutions:**

The term tonicity refers to the relative concentration of solutes in the solutions being compared.

**Types of Solutions:**

According to tonicity of solutions, the solutions can be categorized into three types:

**1. Hypertonic Solution:**

A hypertonic solution has relatively more solute.

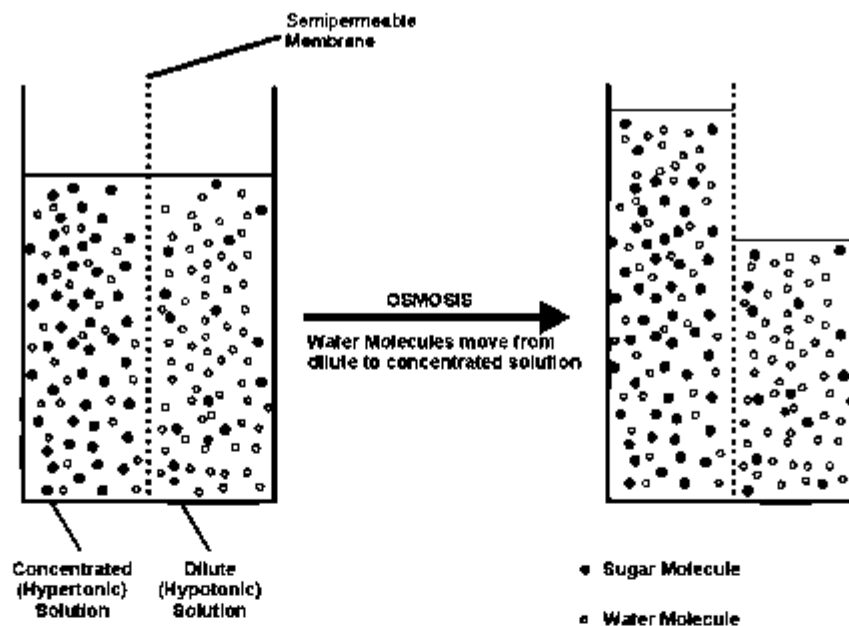
**2. Hypotonic Solution:**

A hypotonic solution has relatively less solute.

**3. Isotonic Solution:**

An isotonic solution has equal concentrations of solutes.





### WATER BALANCE PROBLEMS

#### **ANIMAL CELL:**

##### **Isotonic Solution:**

When animal cell such as red blood cell, is placed in an isotonic solution, the cell volume remains constant because the rate at which water is entering the cell is equal to the rate at which it is moving out.

##### **Hypotonic Solution:**

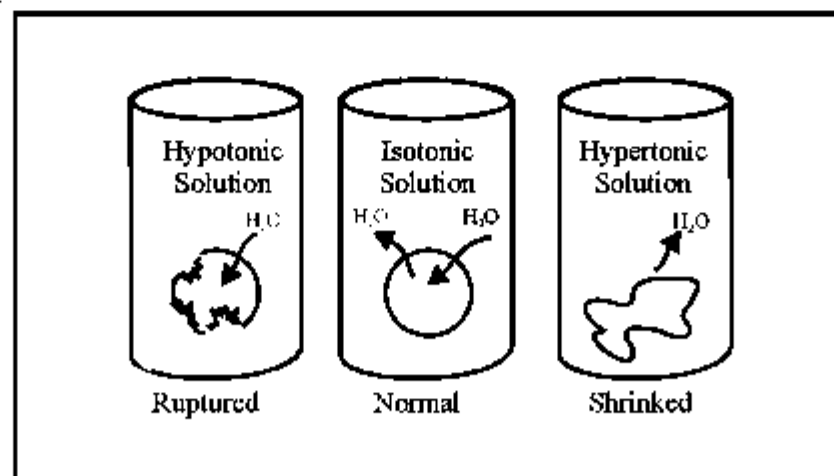
When a cell is placed in a hypotonic solution, water enters and cell swells and may rupture like an over-filled balloon.

##### **Hypertonic Solution:**

When an animal cell is placed in a hypertonic solution it will lose water, and will shrink in size.

##### **Results:**

So in hypotonic environments (e.g. fresh water) animal cells must have ways to prevent excessive entry of water, and in hypertonic environments, (e.g. sea-water) they must have ways to prevent excessive loss of water.



**Figure: Effect of Tonicity on Animal Cell**

#### **PLANT CELLS:**

Water-balance problems are somewhat different for plant cells because of their rigid cell walls.

##### **Hypotonic Solution:**

Most plant cells live in hypotonic environment, i.e. there is low concentration of solutes in extra-cellular fluids than in cells. As a result, water first tends to move first inside cell and then inside vacuole. When vacuole increases in size, cytoplasm presses firmly against the interior of cell wall, which expands a little. Due to the strong cell wall, plant cell wall does not rupture, but instead becomes rigid.

#### **Turgor Pressure:**

The outward pressure on the cell wall exerted by internal water is known as turgor pressure and phenomenon is called Turgor.

#### **Turgid:**

The cell in turgor state is called turgid.

#### **Importance of Turgor:**

The turgor of cells is responsible for maintaining shapes of non – woody plants and soft portions of trees and shrubs.

#### **Isotonic Solution:**

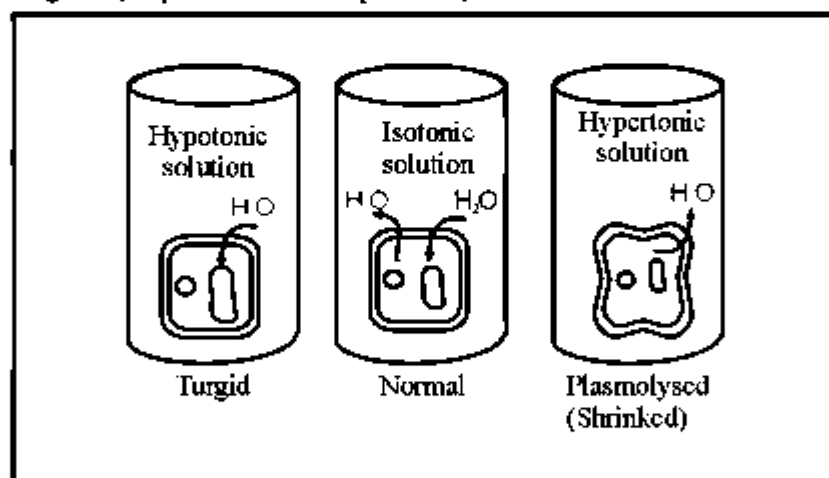
In isotonic environment, the net uptake of water is not enough to make the cell turgid, and it is flaccid (loose, not firm).

#### **Hypertonic Solution:**

In a hypertonic environment, a plant cell loses water and cytoplasm shrinks.

#### **Plasmolysis:**

The shrinking of cytoplasm is called plasmolysis.



**Figure: Effect of Tonicity on Plant Cell**

**Q.24** Discuss the role of osmosis in turgidity of guard cells.

**Text Book page # 72**

**Ans:**

#### **OSMOSIS AND GUARD CELLS**

#### **Guard Cells:**

Stomata, the openings in leaf epidermis are surrounded by guard cells.

#### **During Day Time/Opening of Stomata:**

During day time, guard cells are making glucose, and so are hypertonic (have a higher concentration of glucose) than their nearby epidermal cells. Water enters them from other cells and they swell. Hence they assume a rigid bowed shape and a pore is created between them.

**At Night Time/Closing of Stomata:**

At night, there is low solute concentration in guard cells, water leaves them and they become flaccid. In this form, both guard cells rest against each other and the opening is closed.

**Q.25 Discuss the application of semi-permeable membrane.**

**Ans:** **APPLICATION OF SEMI-PERMEABLE MEMBRANES**

The knowledge of semi-permeable membranes is applied for various purposes.

- Artificially synthesized semi-permeable membranes are used for the separation of bacteria from viruses because bacteria cannot cross a semi permeable membrane
- In advanced water treatment technologies, membrane based filtration systems are used. In this process, semi-permeable membranes separate salts from water (reverse osmosis).

**Q.26 Write a note on filtration.**

**Ans:** **FILTRATION**

**Definition:**

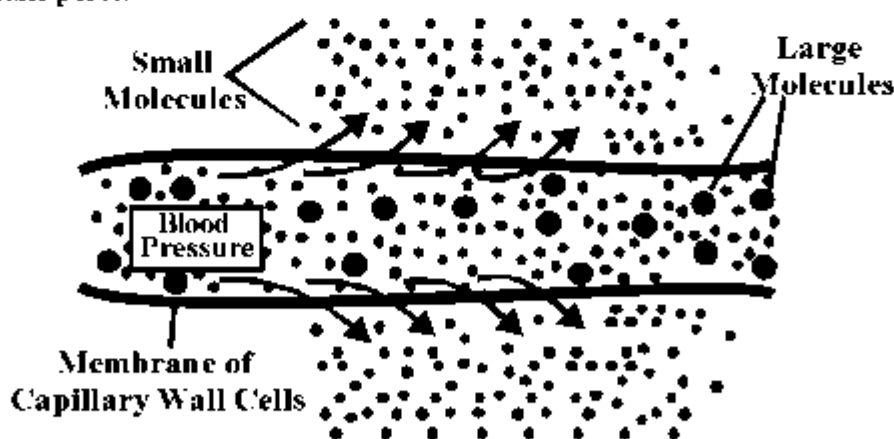
A process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure, or blood pressure is called filtration.

**Example:**

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells.

**Fate of Large Molecules:**

In filtration, the pressure cannot force large molecules, such as proteins, to pass through the membrane pores.



**Figure: Filtration through the Cell Membrane of Capillary Wa**

**Q.27** Write a note on active transport.

Text Book page # 73

**Ans:**

### ACTIVE TRANSPORT

#### **Definition:**

The movement of molecules from an area of lower concentration to the area of higher concentration, with the expenditure of energy in the form of ATP is called active transport.

#### **Concentration Gradient:**

In active transport the movement is against the concentration gradient.

#### **Utilization of Energy:**

In this process, carrier proteins of cell membrane use energy to move the molecules against the concentration gradient.

#### **Sodium-Potassium Pump:**

The membranes of nerve-cells have carrier proteins in the form of sodium-potassium pump. In a resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain a higher concentrations of  $K^+$  and lower concentrations of  $Na^+$  inside the cell. For this purpose, the pump actively moves  $Na^+$  to the outside of the cell where they are already in the higher concentration. Similarly it moves  $K^+$  from outside to inside where they are in higher concentration.

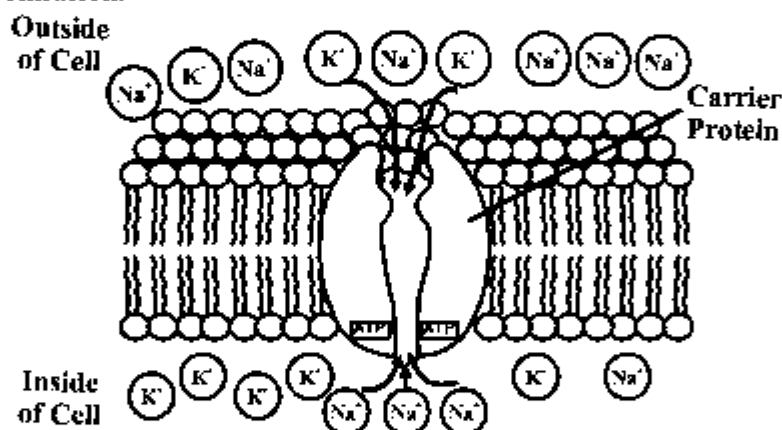


Figure: Sodium-Potassium Pump, Showing Active Transport

**Q.28** Write a note on endocytosis and exocytosis.

Text Book page # 73+74

**Ans:**

### ENDOCYTOSIS

#### **Definition:**

The process of cellular ingestion of bulky materials by the infolding of cell-membrane is called endocytosis.

#### **Types of Endocytosis:**

There are two forms of endocytosis:

1. **Phagocytosis:**  
It is also called as Cellular eating. Cell takes in solid materials.
2. **Pinocytosis :**

It is also called as Cellular drinking. Cell takes in liquid in the form of droplets.

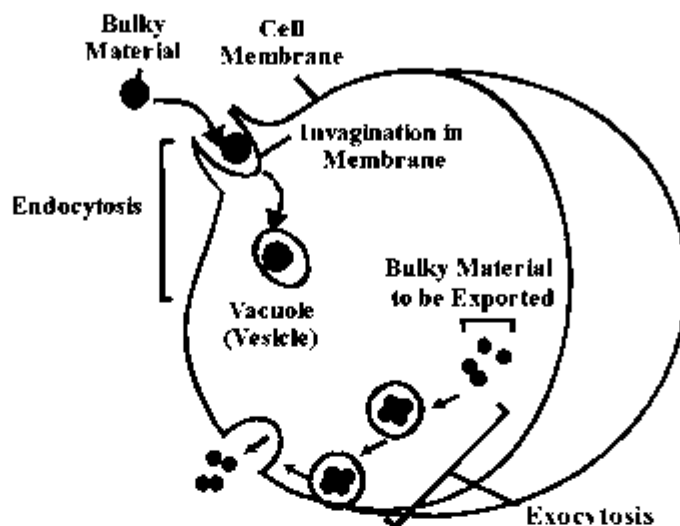
### EXOCYTOSIS

#### **Definition:**

The process through which bulky material is exported outside the cell is called exocytosis.

#### **Significance:**

This process adds new membrane which replaces the part of cell membrane lost during endocytosis.



**Figure: Endocytosis and Exocytosis**

**Q.29 Write a note on animal tissues.**

**Text Book page # 75+76+77**

**Ans:**

### ANIMAL TISSUES

In the bodies of animals, there are four major categories of tissues:

1. Epithelial tissue
2. Connective tissue
3. Muscle tissue
4. Nervous tissue

### EPITHELIAL TISSUE

**(LHR 2012)**

#### **Location:**

Epithelial tissue covers the outside of the body and lines organs and cavities.

#### **Closely Packed Cells;**

The cells in this tissue are very closely packed together.

#### **Types:**

The epithelial tissue has many types on the basis of shape of cells as well as the number of cell layers. Some types include:

1. **Squamous Epithelium:**

Squamous epithelium consists of a single layer of flat cells.

#### **Location:**

It is found in lungs, heart and blood vessels.

#### **Function:**

It allows the movement of materials across it

2. **Cuboidal Epithelium:**

Cuboidal epithelium consists of a single layer of cube-shaped cells.

**Location:**

It is found in kidney tubes and small glands.

**Function:**

It makes secretions.

3. **Columnar Epithelium:**

Columnar epithelium has elongated cells.

**Location:**

It is found in alimentary canal, gall-bladder.

**Function:**

It makes secretions.

4. **Ciliated Columnar Epithelium:**

Ciliated columnar epithelium has elongated cells with cilia.

**Location:**

It is present in trachea and bronchi.

**Function:**

It propels mucus.

5. **Stratified Squamous Epithelium:**

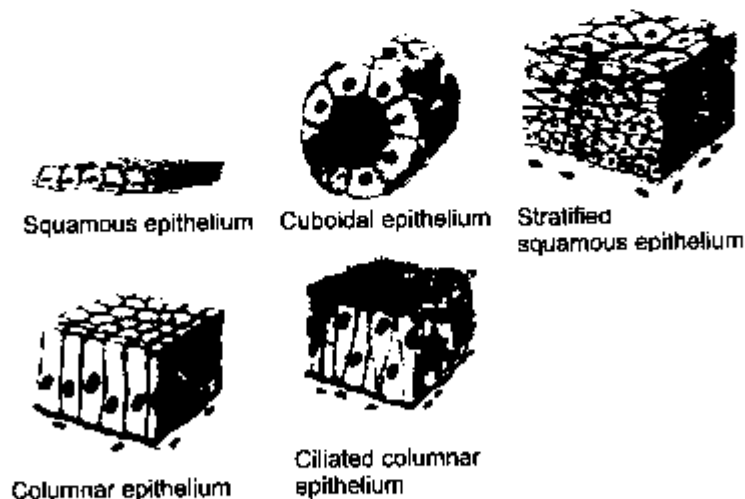
Stratified Squamous Epithelium has many layers of flat cells.

**Location:**

It is present in the lining of oesophagus and mouth and also covers the skin.

**Function:**

It protects inner parts.



**Figure: Epithelial Tissues in Animals**

**CONNECTIVE TISSUE**

**Structure:**

The connective tissue has cells scattered throughout an extracellular matrix.

**Function:**

- The connective tissue serves a 'connecting' function.
- It supports and binds other tissues.

**Examples:**

Common examples of connective tissue are:

- **Cartilage**

Found around the ends of bones, in external ear, nose, trachea

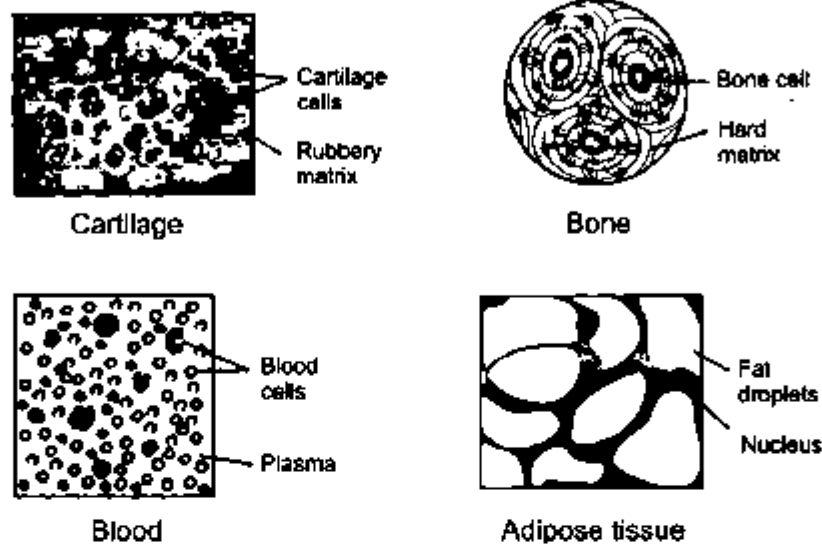
- **Bone**

- **Blood**

- **Adipose Tissue**

Found around kidneys, under skin, in abdomen

Adipose tissue provides energy and supports organs.



**Figure: Connective Tissues in Animals**

### **MUSCLE TISSUE**

**Introduction:**

Muscle tissue is the most abundant tissue in an animal.

**Composition:**

Muscle tissue consists of bundles of long cells called 'muscle fibers'.

**Function:**

They have the ability to contract.

**Types of Muscle Tissues:**

There are three kinds of muscle tissue:

**1. Skeletal Muscles:**

Skeletal muscles or striated muscles are attached to bones.

**Structure:**

The cells are striated (striped) and contain many nuclei.

**Function:**

They are responsible for the movements of bones

**2. Smooth Muscles:**

Smooth muscles are found in the walls of:

- Alimentary canal
- Urinary bladder
- Blood vessels

**Structure:**

They contain smooth (non-striated) cells, each with a single nucleus.

**Function:**

They are responsible for the movement of substances.

### 3. Cardiac Muscles:

Cardiac muscles are present in the wall of heart.

#### Structure:

Their cells are striated but with a single nucleus in each cell.

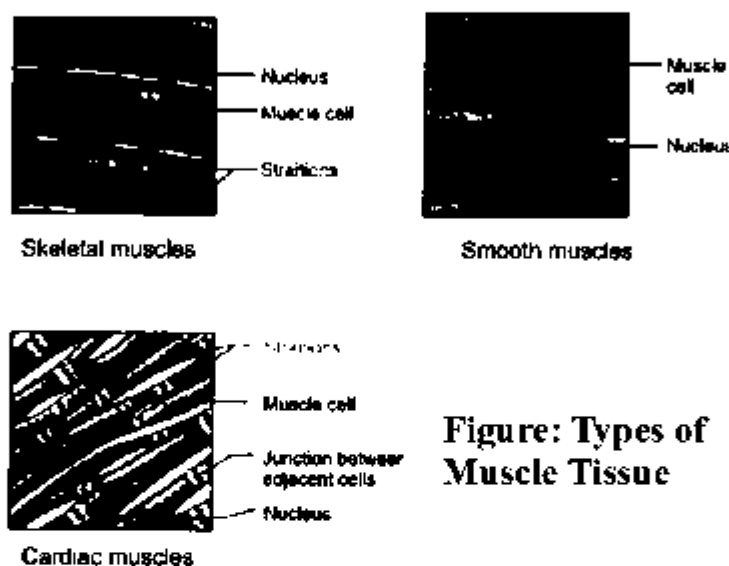
#### Function:

They produce heartbeat.

#### Voluntary and Involuntary Muscles:

Skeletal muscles are voluntary in action, i.e. their contraction is under the control of our will.

Smooth and cardiac muscles are involuntary in action, i.e. their contraction is not under the control of our will.



**Figure: Types of Muscle Tissue**

### NERVOUS TISSUE

An animal's survival depends on its ability to respond approximately to the stimuli from the environment. This ability requires the transmission of information among body parts. Nervous tissue forms a communicating system and performs this task.

#### Composition:

The nervous tissue is mainly composed of nerve cells or neurons.

#### Function:

The nerve tissue is specialized to conduct messages in the form of nerve impulses.

#### Location:

Nervous tissue is found in:

- Brain
- Spinal cord
- Nerves



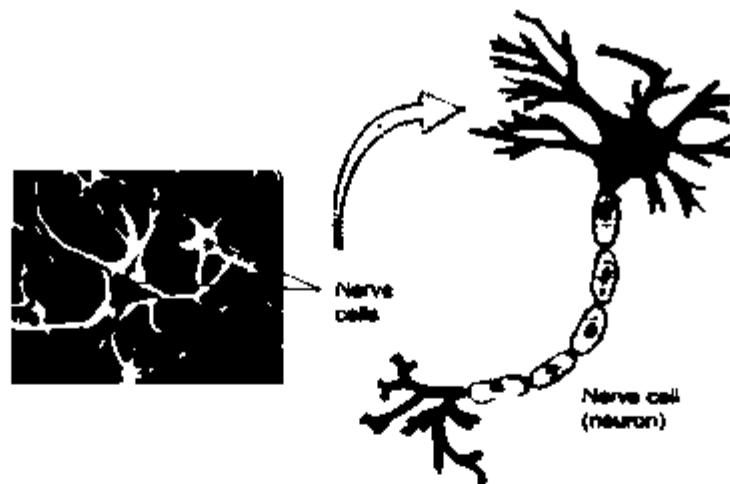


Figure: Nervous Tissue

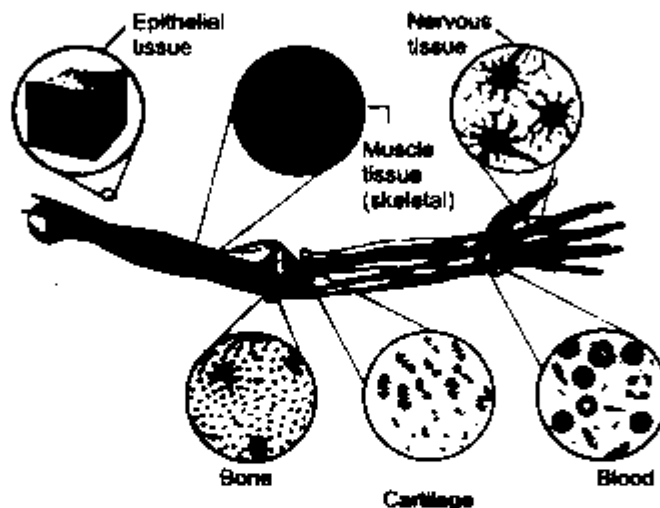


Figure: Different Tissues in Human Body

**Q.30 Write a note on plant tissues.**

**Text Book page # 78**

**Ans:**

### PLANT TISSUES

The cells of plants are grouped into tissues with characteristic functions such as photosynthesis, transport etc.

### MAJOR TYPES

There are two major categories of tissues in plants:

1. Simple tissues
2. Compound (Complex) tissues

### SIMPLE TISSUES

The tissues which are made up of a single type of cells are called simple tissues.

**Types of Simple Tissues**

They are of two types:

- Meristematic tissues

- Permanent tissues

### MERISTEMATIC TISSUES

#### **Characteristics:**

- These tissues are composed of cells, which have the ability to divide.
- The cells are thin-walled.
- These cells have large nucleus.
- They have small or no vacuoles.
- There do not have inter-cellular spaces among them.

#### **Types of Meristematic Tissues:**

There are two main types of meristematic tissues:

#### **1. Apical Meristems:**

Apical meristems are located at the apices (tips) of roots and shoot.

##### **Function:**

When they divide, they cause increase in the length of plant. Such growth is called primary growth.

#### **2. Lateral Meristems:**

Lateral meristems are located on the lateral sides of roots and shoot.

##### **Function:**

When they divide, they are responsible for increase in the growth of plant. Such growth is called secondary growth.

##### **Types:**

They are of further two types:

- Vascular Cambium (located between xylem and phloem)
- Cork Cambium (in the outer lateral sides of plant).

#### **Intercalary Meristem:**

Intercalary meristem is in the form of small patches among mature tissues. These are common in grasses and help in the regeneration of parts removed by herbivores.

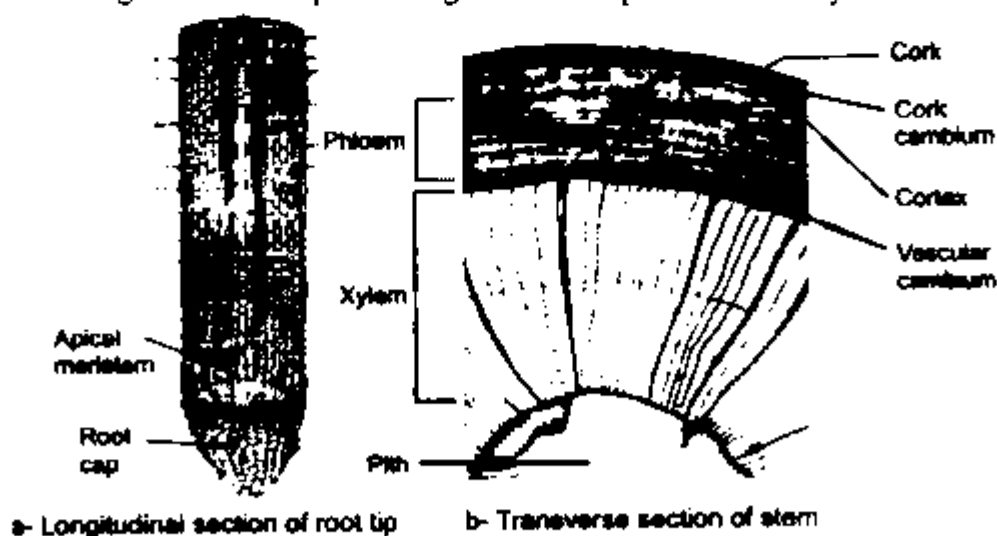


Figure: (a) Apical Meristem at root tip and  
(b) Vascular and Cork Cambium in stem

### PERMANENT TISSUES

#### **Definition:**

Permanent tissues originate from meristematic tissues. The cells of the tissues which do not have the ability to divide are called permanent tissues.

**Types:**

Permanent tissues are classified into the following types:

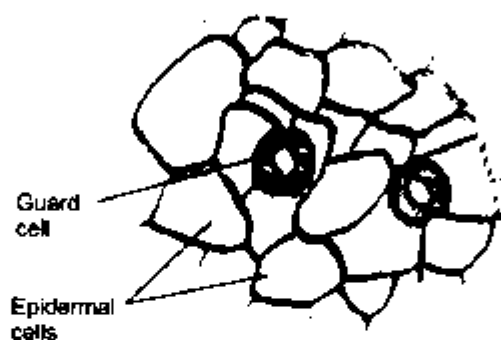
**1. Epidermal Tissues:**

**Introduction:**

Epidermal tissues are composed of a single layer of cells and they cover the plant body.

**Functions**

- They act as barrier between environment and internal plant tissues.
- In roots, they are responsible for the absorption of water and minerals.
- On stem and leaves, they also secrete cutin (the coating of cutin is called cuticle) which prevents evaporation.
- Specialized structures are also present which perform specific functions, e.g. root hair and stomata.



**Figure: Epidermal Tissue**

**2. Ground tissues:**

**Introduction:**

Ground tissues are simple tissues made up of parenchyma cells. Parenchyma cells are the most abundant cells in plants.

**Characteristics:**

- They are spherical but flat at the point of contact..
- They have thin primary cell walls.
- They have large vacuoles for the storage of food.

**Functions**

- In leaves, they are called mesophyll and are the sites of photosynthesis.
- In other parts, they are sites of respiration and protein synthesis.
- They also store food in their vacuoles.

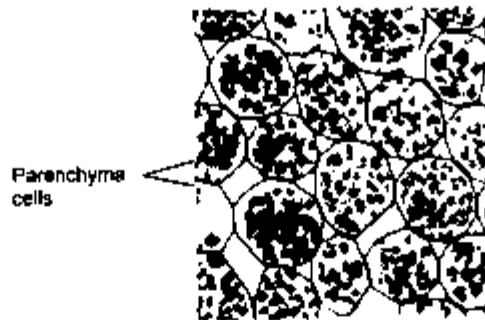


Figure: Ground Tissue

### 3. Support Tissues:

The tissues that provide strength and flexibility to plants are called support tissues. They are further of two types.

#### (i) Collenchymas Tissue:

They are made up of elongated cells with unevenly thickened primary cell walls.

**Location:**

They are found in:

- Cortex (beneath epidermis) of young stems,
- Mid-ribs of leaves
- Petals of flowers

**Function:**

They are flexible and function to support the organs where they are found.

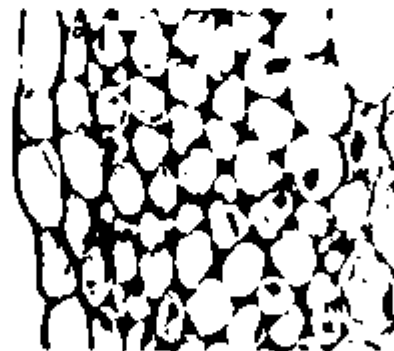


Figure: Sclerenchyma Tissue

#### (ii) Sclerenchyma Tissue:

They are composed of cells with rigid secondary cell walls. The cell walls are hardened with lignin, which is the main chemical component of wood.

**Mature Cells:**

Mature cells cannot elongate and most of them are dead.

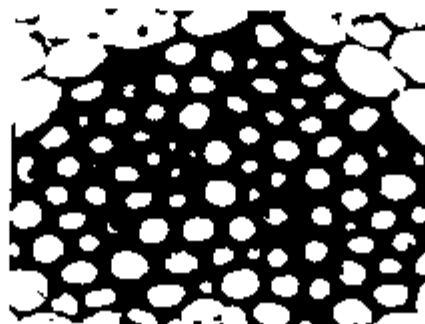


Figure: Sclerenchyma Tissue

**COMPOUND/COMPLEX TISSUES****Definition:**

A plant tissue composed of more than one type of cell is called a compound or complex tissue.

**Occurrence:**

They are found only in vascular plants.

**Examples:**

- Xylem
- Phloem

**1. Xylem Tissue:**

Due to the presence of lignin, the secondary walls of its cells are thick and rigid.

**Types:**

Two types of cells are found in xylem tissue.

**Vessel Elements:**

They have thick secondary cell walls. They lack end walls and join together to make tubes.

**Tracheids:**

They are slender cells with overlapping ends.

**Functions:**

- Xylem tissue is responsible for the transport of water & dissolved substances from roots to the aerial parts.
- It also provides support to the plant body due to the presence of lignin.

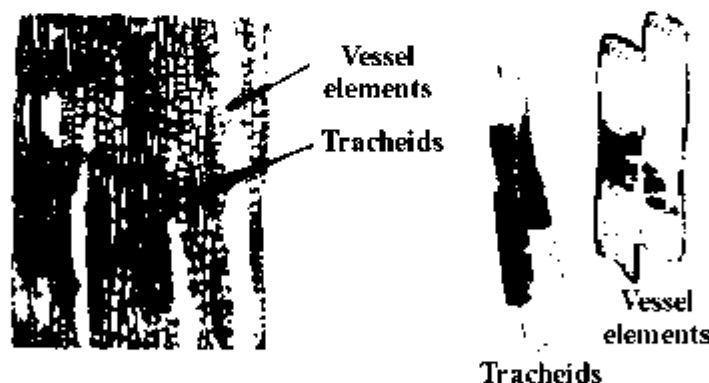


Figure: Xylem Tissue

**2. Phloem Tissue:**

Phloem tissue contains,

**(i) Sieve Tube Cells:**

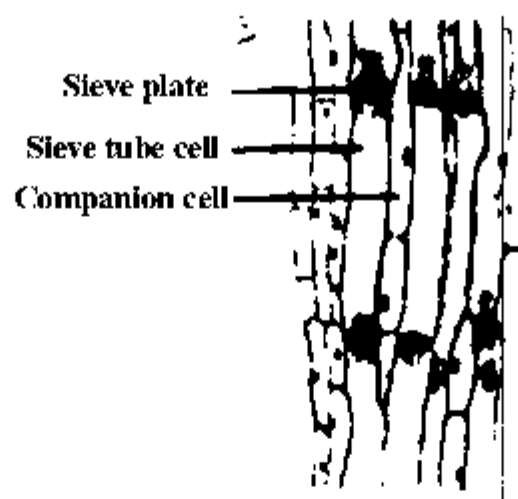
They are long, and their end walls have small pores. Many sieve tube cells join to form long sieve tubes.

**(ii) Companion Cells:**

They make proteins for sieve tube cells.

**Function:**

Phloem tissue is responsible for the conduction of dissolved organic matter (food) between different parts of plant body.



**Figure: Phloem Tissue**

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## **Unit 5: Cell Cycle**

### **Short Questions**

**1. Define Cell cycle. Text Book Page # 87 (LHR 2015, GRW 2013, BWP 2014)**

**Ans: Definition:**

“The series of events from the time a cell is produced until it completes mitosis and produces new cells is called cell cycle”.

The major phases of cell cycle are:

- (i) Interphase
- (ii) Metaphase

**2. Define Interphase.**

**Ans:** “Interphase is the time when a cell’s metabolic activity is very high, as it performs various functions”.

It is divided into three phases:

- (i) G1 Phase (First Gap)
- (ii) S – Phase (Synthesis Phase)
- (iii) G2 Phase (Second Gap)

**3. What are the changes that occur in a cell during G1 phase? (LHR 2012, 2013)**

**Ans:** “This is called as the First Gap. After its production, a cell starts its cell cycle in G1 phase”.

**Events:**

- Cell increases its supply of proteins.
- Cell increases the number of its organelles (mitochondria, ribosomes)
- Cell grows in size.
- Synthesis of various enzymes required in the S Phase, for the duplication of chromosomes.

**4. What do you mean by S-phase? Text Book Page # 88 (SWL 2014, FSD 2015)**

**Ans: S-Phase:**

In this phase, cell duplicates its chromosomes. As a result, each chromosome consists of two sister chromatids.

**5. Describe G2 phase. (MTN 2015, DGK 2015, SGD 2015)**

**Ans:** In the G2 phase, cell prepares proteins that are essential for mitosis, mainly for the production of spindle fibres.

**6. What is G0 phase?**



**Ans:** “Cells that have temporarily or permanently stopped dividing are said to have entered a state of quiescence, called G0 phase. In multicellular eukaryotes, cells enter G0 phase from G1 and stop dividing”.

**Example:**

- Neurons remain in G0 Phase for indefinite period.
- Some cells of liver and kidney enter G0 phase semi-permanently.

**7. Define MITOSIS and describe its discovery.**

**Text Book Page # 89**

**(LHR, GRW2013, BWP 2014, SWL 2015, RWP 2014)**

**Ans: Definition:**

“The type of cell division in which a cell divides into two daughter cells, each with the same number of chromosomes as were present in the parent cell is called mitosis”.

**Discovery:**

In 1880s, a German biologist, Walther Flemming observed that in a dividing cell, nucleus passes through a series of changes which he called mitosis.

**Occurrence:**

- Mitosis occurs only in eukaryotic cells.
- In multicellular organisms, the somatic cells undergo mitosis.

**8. What is the difference between somatic and germ line cells?**

**(LHR, GRW 2014, LHR 2015, SWL 2015)**

**Ans:**

<b>SOMATIC CELLS</b>	<b>GERM LINE CELLS</b>
<ul style="list-style-type: none"><li>• Somatic Cells are those which form the body of organisms.</li><li>• Somatic Cells undergo mitosis.</li></ul>	<ul style="list-style-type: none"><li>• Germ line Cells are those which give rise to gametes.</li><li>• Germ line Cells undergo meiosis.</li></ul>

**9. Why PROKARYOTES do not undergo proper MITOSIS?**

**Ans:** Prokaryotic cells undergo a process similar to mitosis called binary fission. Their division is not called mitosis because they do not have proper nucleus and do not form spindles during division.

**10. What is binary fission?**

**(DGK 2015)**

**Ans:** “It is a type of asexual reproduction in which an organism divides into two parts.”

**Example:**

Prokaryotic cells undergo a process similar to mitosis called binary fission.

**11. Name the phases of MITOSIS in order.**

**(MTN 2015, BWP 2015)**

**Ans:** The process of mitosis is divided into two major phases:

**(a) Karyokinesis:**

The division of nucleus known as karyokinesis is divided into four phases:

- (i) Prophase
- (ii) Metaphase
- (iii) Anaphase

(iv) Telophase

(b) Cytokinesis

The division of cytoplasm is known as cytokinesis.

**12. Define Kinetochore.**

**Ans:** Each chromosome has a kinetochore at centromere. Kinetochore is a complex protein structure that is the point where spindle fibers attach.

**13. What are spindle fibres?**

**Ans:** Centrosomes give rise to microtubules by joining tubulin proteins present in cytoplasm. The microtubules thus formed are called spindle fibres.

- Complete set of spindle fibers is known as the mitotic spindle.

**14. Enlist the important changes that occur in PROPHASE.**

**Ans:** Important changes that occur in prophase are:

(i) **Chromosome:**

At the onset of prophase, chromatin condenses into highly ordered structures called chromosomes.

(ii) **Kinetochore:**

Each chromosome has kinetochore at centromere where spindle fibers attach.

(iii) **Migration of Centrosomes:**

Both centrosomes migrate to opposite poles of cell.

(iv) **Formation of Mitotic Spindle:**

Centrosome give rise to microtubules by joining tubulin proteins present in cytoplasm. The microtubules thus formed are called spindle fibers.

(v) **Nuclear Changes:**

Nucleolus and nuclear envelope have degraded, and spindle fibres have invaded the central space.

**15. What is Telophase?**

**Ans:** It is the last phase of karyokinesis in mitosis.

The events that occur in Telophase are:

- Telophase is the reversal of prophase.
- A new nuclear envelope forms around each set of separated chromosomes.
- Both sets of chromosomes, now surrounded by new nuclear envelopes, unfold back into chromatin. Nuclear division is completed.

**16. What is difference in CYTOKINESIS in animal and plant cells?**

Text Book Page # 90 (LHR 2016)

**Ans: Definition:**

“The division of cytoplasm is called cytokinesis”.

**Cytokinesis in Animal Cells:**

- In animal cells, cytokinesis occurs by a process known as cleavage.
- A cleavage furrow develops where the metaphase plate used to be.

- The furrow deepens and eventually pinches the parent cell into two daughter cells.

#### **Cytokinesis in Plant Cells:**

- In plant cells, vesicles derived from Golgi apparatus move to the middle of the cell.
- These vesicles fuse to form a membrane-bounded disc which is called cell plate or phragmoplast.
- This plate grows outward and more vesicles fuse with it.
- Finally, the membranes of cell plate fuse with plasma membrane, and its contents join the parental cell wall.
- The result is two daughter cells, each bounded by its own plasma membrane and cell wall.

**17. Define phragmoplast.**

**(SGD 2014)**

**Ans:** Phragmoplast:

“Cytokinesis in plant cells occurs differently. Vesicles derived from the Golgi apparatus move to the middle of cell and fuse to form a membrane bounded disc called cell plate or phragmoplast.”

**18. Nucleus is only visible in interphase while chromosomes are only visible in cell division stage. Why is that?**

**Ans:** Nuclear membrane breaks during cell division so there is no distinct nucleus. In interphase, nuclear material is in the form of fine chromatin which condenses during prophase to get into the shape of chromosomes.

**19. What is importance of MITOSIS?**

**Text Book Page # 92**

**Ans:** The importance of mitosis is the maintenance of chromosomal set, i.e. each daughter cell receives chromosomes that are alike in composition and equal in number to the chromosomes of parent cell.

**20. Define regeneration.**

**(SWL 2014, DGK 2014, MTN 2015, SGD 2014)**

**Ans:** “The process in which an organism can regenerate its lost parts through mitosis is called regeneration.”

**Example:**

Sea Star regenerates its lost arms through this process.

**21. How mitosis helps in Asexual reproduction?**

**Text Book Page # 93**

**Ans:** Some organisms produce genetically similar offsprings through asexual reproduction. Mitosis is a means of asexual reproduction.

**Example:**

Hydra reproduces asexually by budding. The cells at the surface of hydra undergo mitosis and form a mass called bud. Mitosis continues in the cells of bud and it grows into a new individual.

**22. What can be the results of ERRORS in MITOSIS?**

**Ans:** Errors in the control of mitosis may cause cancer.

### **Tumor Development:**

All cells have genes that control the timing and number of mitosis. Sometimes mutations occur in such genes and cells continue to divide. It results in growths of abnormal cells called tumors.

There are following types of tumors.

- (i) Benign Tumor
- (ii) Malignant Tumor

### **23. What is difference between Malignant and Benign tumor?**

(LHR 2014, GRW 2015, MTN 2015, SGD 2015)

**Ans:** As long as tumors remain in their original location, they are called benign tumors. But if they invade other tissues, they are called malignant (cancerous) tumors and their cells are called cancer cells.

### **24. Define Metastasis.**

(BWP 2015)

**Ans:** "Malignant tumors can send cancer cells to other parts in body where new tumors may form. This phenomenon is called metastasis (spreading of disease)."

### **25. Define Meiosis.**

Text Book Page # 95 (LIIR 2013)

**Ans: Meaning:**

The word meiosis comes from Greek word 'Meioun' meaning "to make smaller" since it results in a reduction in chromosome number.

**Definition:**

"The process by which one diploid (2n) eukaryotic cell divides to generate four haploid (1n) daughter cells is called meiosis."

Meiosis occurs in two phases:

- (i) Meiosis I
- (ii) Meiosis II

### **26. What is the difference between diploid and haploid cells? (GRW 2012, SGD 2014)**

**Ans:** Diploid means the cells in which chromosomes are in pairs (homologous pairs) while haploid means the cells with half the number of chromosomes i.e. chromosomes are not in the form of pairs.

### **27. Define Synapsis.**

Text Book Page # 96 (FSD 2014)

**Ans:** During prophase I the homologous chromosomes line up with each other and form pairs by a process called synapsis.

### **28. What is the difference between Meiosis-I and Meiosis-II?**

**Ans:**

MEIOSIS-I	MEIOSIS-II
• In Meiosis-I, the homologous chromosomes in a diploid cell separate	• In meiosis-II, two haploid cells separate and so four haploid daughter cells are

and so two haploid daughter cells are produced.

- It is the step in meiosis that generates genetic variations.
- Prophase-I takes more time.

produced. It is the second part of meiosis and is similar to mitosis.

- It is the step in meiosis where no genetic variation takes place.
- Prophase-II takes less time.

**29. Describe process of CROSSING OVER in MEIOSIS?**

(LHR 2013, SWL 2014, MTN 2014, DGK 2015, BWP 2015, SGD 2015, RWP 2015)

**Ans:** "The non-sister chromatids of homologous chromosomes exchange their segments. This phenomenon is known as crossing over."

**Significance of Crossing Over:**

The exchange of segments results in the recombination of genetic information. After crossing over, each pair of homologous chromosomes remains as a bivalent.

**30. What is the contribution of Thomas Hunt Morgan?**

**Text Book Page # 97**

**Ans:** In 1911, the American geneticist Thomas Hunt Morgan observed the phenomenon of crossing over in fruit fly *Drosophila melanogaster*.

**31. During crossing over, genetic material is exchanged between sister/non-sister chromatids of homologous/non-homologous chromosomes?**

**Ans:** Non-sister chromatids of homologous chromosomes.

**32. What is Inter-kinesis?**

**Ans:** "After meiosis I, both haploid daughter cells enter a period of rest, known as interkinesis or interphase II."

**Difference:**

The interphase II is different from interphase of mitosis and meiosis I. There is no S Phase and so there is no duplication of chromosomes during this stage.

**33. What is the importance of Meiosis according to August Weismann?**

**Text Book Page # 100**

**Ans: Role of August Weismann:**

The significance of meiosis for reproduction and inheritance was described in 1890 by a German biologist August Weismann. He pointed out that:

"Meiosis was necessary not only to maintain the number of chromosomes in the next generation, but also to produce variations in the next generation."

**34. What kind of error can occur during Meiosis?**

**(GRW 2014, FSD 2014)**

**Ans: Disjunction:**

"During Anaphase I, chromosomes separate and go to opposite poles, while during anaphase II, sister chromosomes separate. This is called Disjunction."

**Non-disjunction:**

Sometimes the separation of chromosomes is not normal and it is called as 'Non-disjunction'. Non-disjunction results in the production of gametes which have either more or less than the

normal number of chromosomes. If such an abnormal gamete fuses with a normal gamete, it results in an abnormal number of chromosomes in the next generation.





**Example:**

45 or 47 chromosomes in humans

**35. State any two major differences between MITOSIS and MEIOSIS.**

Text Book Page # 101

**Ans:**

MITOSIS	MEIOSIS
 <p><b>PROPHASE</b></p> <ul style="list-style-type: none"> <li>Homologous chromosomes do not form pairs. There is no crossing over.</li> </ul>	 <p><b>PROPHASE I</b></p> <ul style="list-style-type: none"> <li>In prophase I, there is pairing of chromosomes and crossing over between homologous chromosomes.</li> </ul>
 <p><b>METAPHASE</b></p> <ul style="list-style-type: none"> <li>Single chromosomes align to form metaphase plate.</li> </ul>	 <p><b>METAPHASE I</b></p> <ul style="list-style-type: none"> <li>Homologous pairs align to form metaphase plate.</li> </ul>

**36. Define Apoptosis and describe its advantages.**

Text Book Page # 102

(LHR 2015, RWP 2015)

**Ans: Definition:**

“The type of cell death which is well-programmed and regulated is called apoptosis.”

- Apoptosis can occur when a cell is damaged or undergo stress conditions. Apoptosis removes the damaged cell, preventing it from getting further nutrients.
- Apoptosis prevents the spread of infection.
- Apoptosis also gives advantages during development.

**Example:**

During the formation of fingers, the cells between them undergo apoptosis and the digits separate.

**37. Define blebs. What is an other name of these?**

(LHR 2016)

**Ans:** Cell membrane makes irregular buds known as blebs. Blebs break off from the cell and are now called apoptotic bodies, which are then phagocytosed by other cells.

**38. Define Necrosis and describe its causes.**

**Text Book Page # 103**

**Ans: Definition:**

“The accidental death of cells and living tissues is called necrosis.”

**Causes of Necrosis:**

There are many causes of necrosis, including:

- Injury
- Infection
- Cancer
- Hypoxic environment
- Lack of proper care to a wound site
- Spider bites

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## Unit 5: Cell Cycle

### Multiple Choice Questions

1. The series of events from the time a cell is produced until it completes mitosis and produces new cells: Text Book page#87  
(a) Cell cycle (b) Interphase  
(c) Karyokinesis (d) Cytokinesis
2. During interphase  
(a) Cell's metabolic activity takes place (b) Duplication of chromosomes takes place  
(c) Cell is divided into two daughter cells (d) Both a and b
3. The major phases of cell cycle are: (GRW 2013)  
(a) 5 (b) 4  
(c) 3 (d) 2
4. Interphase is divided into how many phases? (LHR 2012)  
(a) Four (b) Three  
(c) Two (d) One
5. Which of the following is the longest phase in cell cycle? (BRW 2015)  
(a) Mitotic phase (b) Inter phase  
(c) G<sub>0</sub> phase (d) G<sub>1</sub> phase
6. During G<sub>1</sub> phase:  
(a) Cell increases its supply of proteins (b) Increases its number of organelles  
(c) Synthesis of enzymes and duplication of chromosomes  
(d) All of these
7. In which stage of cell cycle, the cell is preparing enzymes for chromosomes duplication? (SWL 2014)  
(a) S-phase (b) G-1 phase  
(c) G-2 phase (d) M-phase
8. In which phase cell duplicates its chromosomes? Text Book page#88  
(SDG 2015, GWL 2013, LHR 2012, 2016)  
(a) G<sub>1</sub> phase (b) S phase  
(c) G<sub>2</sub> phase (d) G<sub>0</sub> phase
9. The phase of inter phase in which cell prepares proteins for mitosis: (GRW 2014)  
(a) G<sub>1</sub> phase (b) S phase  
(c) G<sub>2</sub> phase (d) G<sub>0</sub> phase
10. At which stage of cell cycle cell stop dividing? (SGD 2015)  
(a) G<sub>0</sub> (b) G<sub>1</sub>  
(c) G<sub>2</sub> (d) S
11. The cells that do not enter G<sub>0</sub> phase and continue to divide through out an organism's life:  
(a) Neurons (b) Epithelial cells  
(c) Liver cells (d) Kidney cells
12. Mitosis was discovered in: Text Book page#89  
(a) 1860 (b) 1870  
(c) 1880 (d) 1890
13. Who discovered mitosis?  
(a) Walther Flemming (b) Oscar Hertwig  
(c) T. H. Morgan (d) August Weismann

14. Prokaryotic cells undergo a process similar to mitosis called:  
 (a) Binary fission (b) Multiple fission  
 (c) Regeneration (d) Meiosis
15. The division of cytoplasm: (LHR 2015, GRW 2012)  
 (a) Karyokinesis (b) Cytokinesis  
 (c) Prophase (d) Metaphase
16. The division of nucleus is called: (SGD 2014)  
 (a) Karyokinesis (b) Cytokinesis  
 (c) Prophase (d) Metaphase
17. Mitosis consist of phases: (LHR 2014)  
 (a) One (b) Two  
 (c) Three (d) Four
18. During mitosis one cell divides into daughter cells: (FSD 2014)  
 (a) 2 (b) 3  
 (c) 4 (d) 5
19. Which of the following is the longest phase of karyokinesis?  
 (a) Prophase (b) Metaphase  
 (c) Anaphase (d) Telophase
20. Complete set of spindle fibres is known as: (RWL 2015)  
 (a) Chromatin (b) Kinetochore  
 (c) Mitotic spindle (d) Cleavage
21. Spindle fibers are formed during: Text Book Page # 89 (LHR 2013, 2015)  
 (a) Prophase (b) Metaphase  
 (c) Anaphase (d) Telophase
22. The chromosomes arrange themselves along the equator of the cell in phase:  
 (MTN 2015, SWL 2015)  
 (a) Prophase (b) Metaphase  
 (c) Anaphase (d) Telophase
23. Which phase is a reversal of prophase? Text Book Page # 90  
 (a) Interphase (b) Metaphase  
 (c) Anaphase (d) Telophase
24. In animal cells, cytokinesis occurs by a process known as:  
 (a) Regeneration (b) Cleavage  
 (c) Binary fission (d) Both (a) and (b)
25. New red blood cells are formed by: Text Book Page # 92  
 (a) Mitosis (b) Meiosis  
 (c) Multiple fission (d) Both a & b
26. Which animal shows regeneration? (DGK 2015)  
 (a) Amoeba (b) Paramecium  
 (c) Sea star (d) Hydra
27. Budding takes place in: Text Book Page # 93  
 (a) Amoeba (b) Paramecium  
 (c) Sea star (d) Hydra
28. Asexual reproduction in hydra is takes place by: (RWL 2015)  
 (a) Mitosis (b) Budding  
 (c) Cutting (d) Spore
29. Tumors are produced as a result of errors in: (LHR 2013)  
 (a) Meiosis (b) Mitosis  
 (c) Binary fission (d) Multiple fission
30. Errors in the control of mitosis may cause: (DGK 2015)  
 (a) Cancer (b) Ulcer  
 (c) Constipation (d) Cough

31. The tumors which remain at their production site are called: (GRW 2015)  
 (a) Benign (b) Malignant  
 (c) Metastasis (d) All of these
32. The phenomenon of spreading cancer:  
 (a) Infection (b) Regeneration  
 (c) Metastasis (d) All of these
33. The word meiosis comes from: Text Book Page # 95  
 (a) Latin word (b) Italian word  
 (c) Greek word (d) French word
34. Who discovered meiosis?  
 (a) Walter Flemming (b) Oscar Hertwig  
 (c) August Weismann (d) T. H. Morgan
35. Meiosis takes place in:  
 (a) Eukaryotic cells (b) Prokaryotic cells  
 (c) Haploid cells (d) All of these
36. Those cell which give rise to gametes are called: (I.H.R 2014)  
 (a) Somatic cells (b) Spindle Fibers  
 (c) Germs line cells (d) All of these
37. Meiosis was discovered in: Text Book Page # 87  
 (a) 1875 (b) 1876  
 (c) 1877 (d) 1878
38. In meiosis, one diploid cell divides into how many haploid cells?  
 (a) 2 (b) 4  
 (c) 6 (d) 8
39. The longest phase in meiosis is: (SGD 2014, BWL 2014)  
 (a) Prophase I (b) Metaphase I  
 (c) Anaphase I (d) Telophase I
40. In which phase chromosomes form a meta phase plate?  
 (a) Prophase (b) Metaphase  
 (c) Anaphase (d) Telophase
41. In which phase of meiosis the pairs of homologous chromosomes align along equatorial plane forming the metaphase plate?  
 (a) Prophase I (b) Metaphase I  
 (c) Anaphase I (d) Telophase I
42. The process in which homologous chromosomes line up with each other and form pairs: Text Book page # 96  
 (a) Tetrad (b) Crossing over  
 (c) Chiasmata (d) Synapsis
43. Who discovered crossing over? Text Book page # 97  
 (a) Walter Flemming (b) Oscar Hertwig  
 (c) August Weismann (d) T. H. Morgan
44. The phase in which crossing over occurs: (FSD 2015)  
 (a) Anaphase (b) Metaphase  
 (c) Prophase II (d) Prophase I
45. The two non-sister chromatids of homologous chromosomes join each other at:  
 (a) Centromere (b) Kinetochore over  
 (c) Chiasmata (d) All of these
46. Thomas Hunt Morgan observed crossing over in *Drosophila melanogaster* in: (MTN 2015)  
 (a) 1905 (b) 1907

- (c) 1909 (d) 1911
47. August Weismann described the significance of meiosis in: Text Book page#100  
(a) 1890 (b) 1891  
(c) 1892 (d) 1893
48. Many haploid fungi and protozoans produce haploid gametes through:  
(a) Mitosis (b) Meiosis  
(c) Regeneration (d) Budding
49. The diploid sporophyte generation produces haploid spores through:  
(a) Mitosis (b) Meiosis  
(c) Budding (d) Fragmentation
50. Gametophyte generation produces haploid gametes through:  
(a) Mitosis (b) Meiosis  
(c) Budding (d) Fragmentation
51. The abnormal separation of homologous chromosomes during anaphase I of meiosis I:  
(a) Disjunction (b) Non-disjunction  
(c) Synapsis (d) Crossing over
52. The abnormal number of chromosomes in humans:  
(a) 45 or 43 (b) 47 or 45  
(c) 46 (d) All of these
53. The programmed cell death: Text Book page#102  
(a) Necrosis (b) Apoptosis  
(c) Endocytosis (d) Exocytosis
54. In an adult human, the number of cells that die each day by apoptosis:  
(a) 30 - 50 billions (b) 40 - 60 billions  
(c) 50 - 70 billions (d) 60 - 80 billions
55. Blebs break off from the cell and are called:  
(a) Apoptotic bodies (b) Lysosomes  
(c) Both a & b (d) None of these
56. The accidental cell death: Text Book page#103 (BRW 2015)  
(a) Phagocytosis (b) Apoptosis  
(c) Both a & b (d) Necrosis

**ANSWER KEY**

1	a	11	b	21	a	31	a	41	b	51	b
2	d	12	c	22	b	32	c	42	d	52	b
3	d	13	a	23	d	33	c	43	d	53	b
4	b	14	a	24	b	34	b	44	d	54	c
5	b	15	b	25	a	35	a	45	c	55	a
6	d	16	a	26	c	36	c	46	d	56	d
7	b	17	b	27	d	37	b	47	a		
8	b	18	a	28	b	38	b	48	a		
9	c	19	a	29	b	39	a	49	b		
10	a	20	c	30	a	40	b	50	a		

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## Unit 5: Cell Cycle

### Long Questions

**Q.1** Write a note on cell cycle.

Text Book Page # 87 (MTN 2015)

**Ans:**

#### CELL CYCLE

##### **Definition:**

The series of events from the time a cell is produced until it completes mitosis and produces new cells is called cell cycle.

#### MAJOR PHASES OF CELL CYCLE

Cell cycle consists of two major phases:

**1. Interphase:** (GRW 2012, 2013), (LHR 2013), (MTN 2014), (BWP 2015)

Interphase is the time when a cell's metabolic activity is very high, as it performs various functions.

It is divided into three phases:

**(i) G<sub>1</sub> Phase:**

This is called as the First Gap. After its production, a cell starts its cell cycle in G<sub>1</sub> phase.

##### **Events:**

- Cell increases its supply of proteins.
- Cell increases the number of its organelles (mitochondria, ribosomes)
- Cell grows in size.
- Synthesis of various enzymes required in the S Phase, for the duplication of chromosomes.

**(ii) S Phase:**

This phase is the Synthesis Phase.

##### **Event:**

- Cell duplicates its chromosomes as a result, each chromosome consists of two sister chromatids.

**(iii) G<sub>2</sub> Phase:**

This phase is called as the Second Gap.

##### **Event:**

- Cell prepares proteins that are essential for mitosis, mainly for the production of spindle fibers.

##### **Inhibition of Protein Synthesis:**

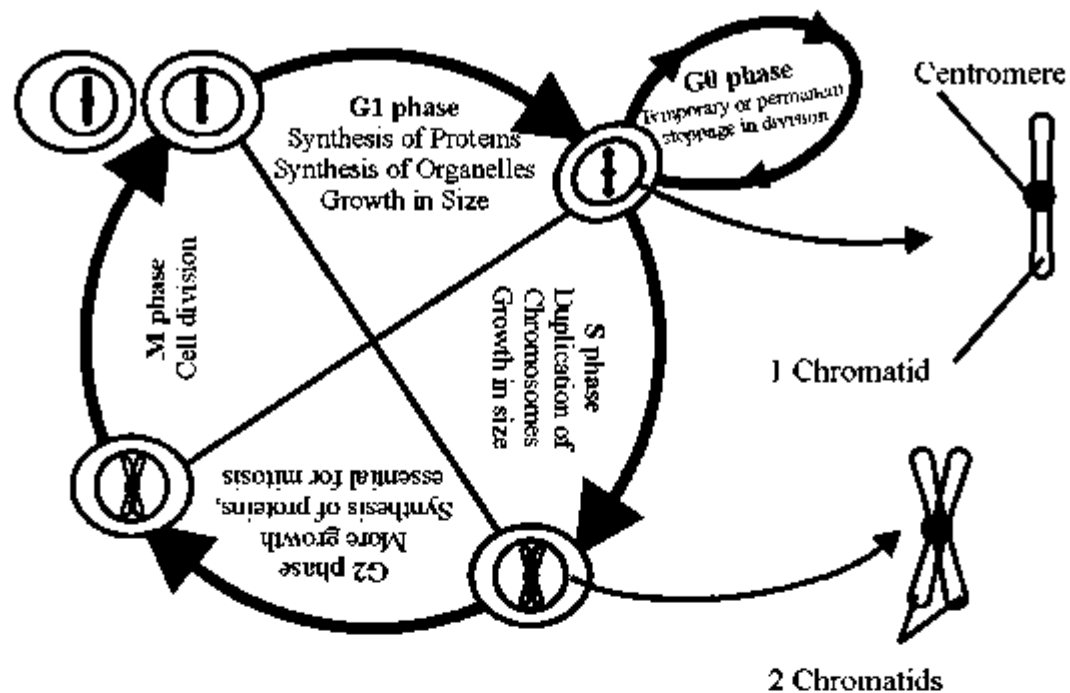
Inhibition of protein synthesis during G<sub>2</sub> phase prevents cell from undergoing mitosis.

##### **Duration:**

Typically, the Inter phase lasts for at least 90% of the total time required for the cell cycle.

**2. M Phase:**

After the G<sub>2</sub> phase of Inter phase, the cell enters the division phase, i.e. M Phase. It is characterized by mitosis, in which cell divides into the two daughter cells.



**Figure: The Eukaryotic Cell Cycle**

**G0 Phase:**

In multicellular eukaryotes, cells enter G0 phase from G1 and stop dividing.

**Permanent G0 Phase:**

Some cells remain in G0 phase for an indefinite period of time.

**Example:**

Neurons

**Semi-permanent G0 Phase:**

Some cells enter G0 phase semi-permanently.

**Example:**

Some cells of liver and kidney

**No G0 Phase:**

Many cells do not enter G0 Phase and continue to divide throughout an organism's life.

**Example:**

Epithelial cells.

**Important:**

The events of cell cycle are ordered and directional i.e. each event occurs in a sequential fashion and it is impossible to "Reverse" the cycle.

**Q.2 Define Mitosis and describe its different phases. Text Book Page # 89(DGK 2014)**

**Ans:** **MITOSIS**

**Discovery:**

In 1880s, a German biologist, Walther Flemming observed that in a dividing cell, nucleus passes through a series of changes which he called mitosis.



**Definition:**

The type of cell division in which a cell divides into two daughter cells, each with the same number of chromosomes as were present in the parent cell is called mitosis.

**Occurrence:**

- Mitosis occurs only in eukaryotic cells.
- In multicellular organisms, the somatic cells undergo mitosis.

**PHASES OF MITOSIS****(SWL 2014)**

The process of mitosis is complex and highly regulated. There are two major phases.

**1. Karyokinesis:**

The division of nucleus is called karyokinesis.

**2. Cytokinesis:**

The division of cytoplasm is called cytokinesis.

**KARYOKINESIS**

The division of nucleus is further divided into four phases.

- (i) Prophase
- (ii) Metaphase
- (iii) Anaphase
- (iv) Telophase

**PROPHASE****(LHR 2013, 2015), (MTN 2015)**

The events that occur in prophase are:

**Chromosome Formation:**

The genetic material in the nucleus is in a loose thread-like form called chromatin. At the onset of prophase, chromatin condenses into highly ordered structures called chromosomes.

**Structure of Chromosome:**

Since, the genetic material has already been duplicated earlier in S phase, each chromosome is made up of two sister chromatids, bound together at a centromere. Each chromosome has a kinetochore at centromere. Kinetochore is a complex protein structure that is the point where spindle fibers attach.

**Migration of Centrosomes:**

There are two centrioles, (collectively called a centromere), close to the nucleus. Each centriole duplicates and thus two daughter centrosomes are formed. Both centrosomes migrate to the opposite poles of the cell.

**Formation of Mitotic Spindle:**

Centrosomes give rise to microtubules by joining tubulin proteins present in cytoplasm. The microtubules thus formed are called spindle fibres. Complete set of spindle fibers is known as the mitotic spindle.

**Nuclear Changes:**

By this time, nucleolus and the nuclear envelope have degraded and the spindle fibers have invaded the central space.

**PROPHASE IN PLANT CELLS:**

In highly vacuolated plant cells, nucleus has to migrate to the center of the cell before prophase. The cells of plants lack centrioles. So, spindle fibers are formed by the aggregation of tubulin proteins on the surface of nuclear envelope during prophase.

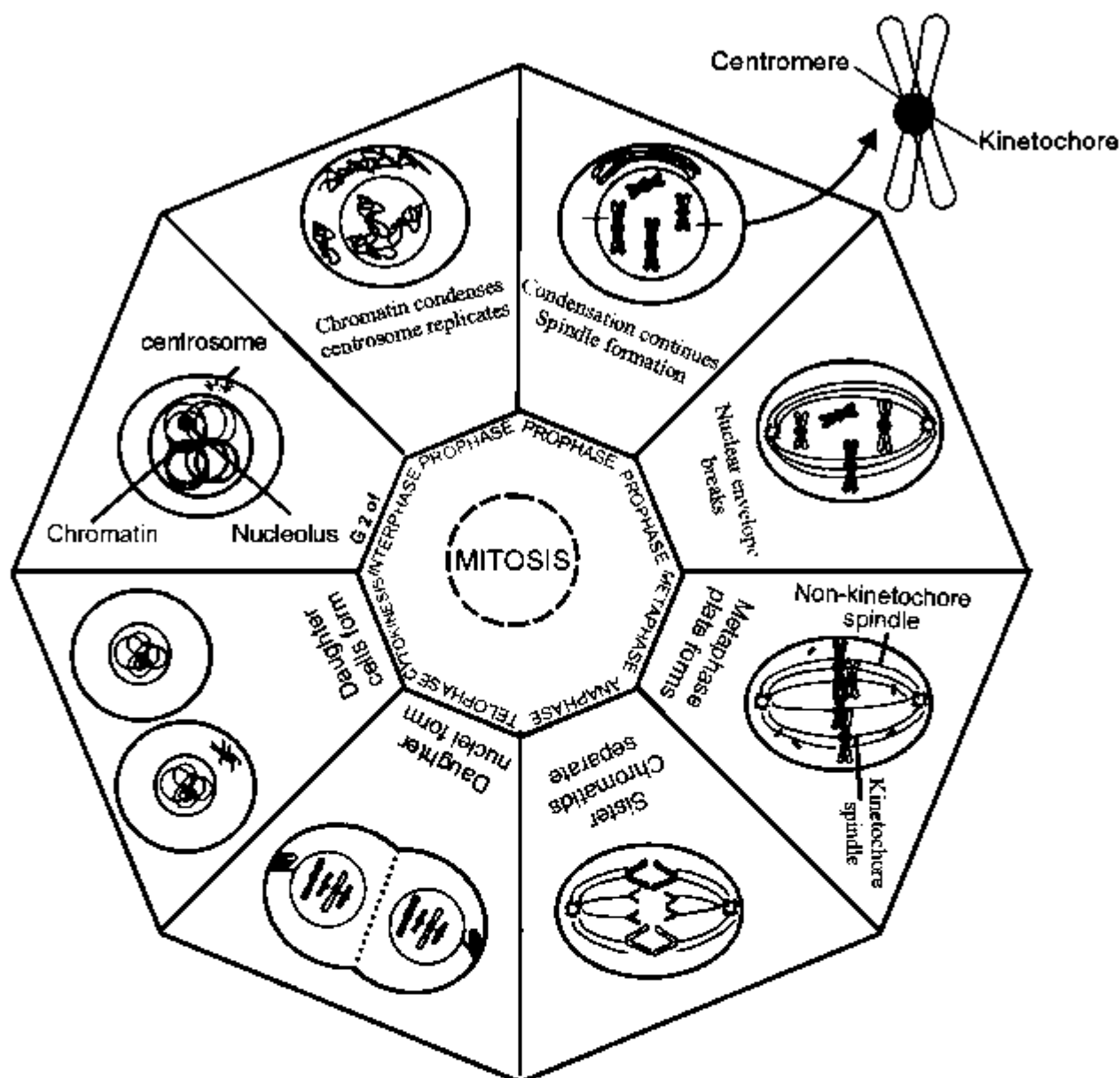


Figure: Stages in Mitosis

**METAPHASE**

(LHR 2015)

The events that occur in metaphase are:

**Formation of Metaphase Plate:**

When spindle fibers have grown to a sufficient length, some spindle fibres known as kinetochore fibres attach with the kinetochores of chromosomes. Two kinetochore fibres from opposite poles attach with each chromosome. Chromosomes arrange themselves along the equator of the cell forming a metaphase plate.

**Non-Kinetochore fibres:**

A number of other fibres (non-kinetochore) from the opposite centrosomes attach with each other.

**ANAPHASE**

(LHR 2015)

The events that occur in Anaphase are:

- When a kinetochore spindle fibre connects with the kinetochore of chromosome, it starts to pull toward the originating centrosomes.

- The pulling force divides the chromosome's sister chromatids and they separate. These sister chromatids are now sister-chromosomes, and they are pulled apart toward the respective centrosomes.
- The other spindle fibres (non-kinetochore) also elongate. At the end of anaphase, cell has succeeded in separating identical copies of chromosomes into two groups at the opposite poles.

### TELOPHASE

The events that occur in Telophase are:

- Telophase is the reversal of prophase.
- A new nuclear envelope forms around each set of separated chromosomes.
- Both sets of chromosomes, now surrounded by new nuclear envelopes, unfold back into chromatin. Nuclear division is completed.

### CYTOKINESIS

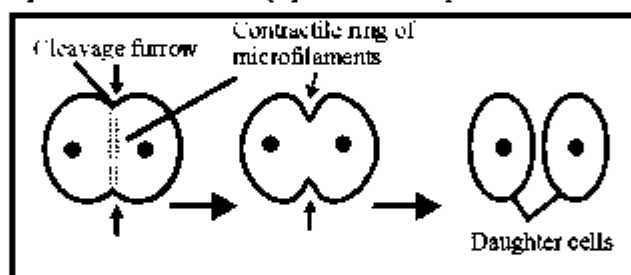
(LHR 2012)

**Definition:**

The division of cytoplasm is called cytokinesis.

**Cytokinesis in Animal Cells:**

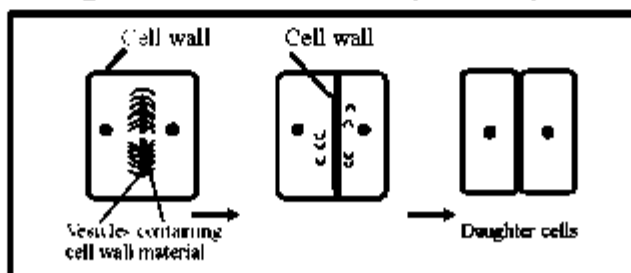
- In animal cells, cytokinesis occurs by a process known as cleavage.
- A cleavage furrow develops where the metaphase plate used to be.
- The furrow deepens and eventually pinches the parent cell into two daughter cells.



**Figure: Cytokinesis in Animal Cell**

**Cytokinesis in Plant Cells:**

- In plant cells, vesicles derived from Golgi apparatus move to the middle of the cell.
- These vesicles fuse to form a membrane-bounded disc which is called cell plate or phragmoplast.
- This plate grows outward and more vesicles fuse with it.
- Finally, the membranes of cell plate fuse with plasma membrane, and its contents join the parental cell wall.
- The result is two daughter cells, each bounded by its own plasma membrane and cell wall.



**Figure: Cytokinesis in Plant Cell**

**Q.3** Describe significance of mitosis.

**Text Book Page # 92**

**(LHR 2016), (DGK 2014, 2015), (RWP 2014), (SGD 2015), (RWP 2015)**

**Ans:**

**SIGNIFICANCE OF MITOSIS**

The importance of mitosis is the maintenance of chromosomal set, i.e. each daughter cell receives chromosomes that are alike in composition and equal in number to the chromosomes of parent cell.

Following are the occasions in the lives of organisms where mitosis happens.

**Development and Growth:**

The number of cells within an organism increase by mitosis. This is the basis of the development of a multicellular body from a single cell, i.e. zygote, and also the basis of growth of multicellular body.

**Cell Replacement:**

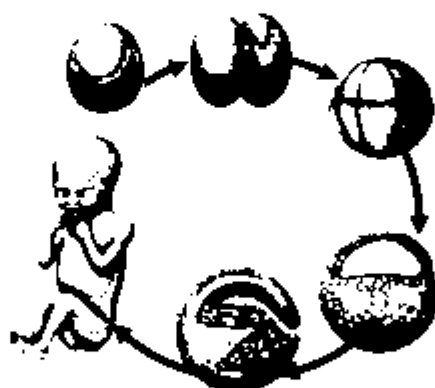
In some body parts, cells are constantly sloughed off and replaced by new ones. New cells are formed by mitosis and are exact copies of the cells being replaced.

**Examples:**

Cells of skin and digestive tract.

**Red Blood Cells:**

Red blood cells have a short life span (about 4 months). New red blood cells are formed by mitosis



**Figure: Development of a single cell (zygote) into a multicellular body**

**Regeneration:**

Some organisms can regenerate parts of their bodies. The production of new cells is achieved by mitosis.

**Example:**

Sea star regenerates its lost arm through mitosis



### Regeneration in Sea Star

#### Asexual Reproduction:

Some organisms produce genetically similar offsprings through asexual reproduction. Mitosis is a means of asexual reproduction.

#### Example:

Hydra reproduces asexually by budding. The cells at the surface of hydra undergo mitosis and form a mass called bud. Mitosis continues in the cells of bud and it grows into a new individual.

#### Vegetative Propagation:

The same division happens during asexual reproduction, i.e. vegetative propagation in plants.



Budding in Hydra



Vegetative Propagation in Plants

Figure: Asexual Reproduction

Q.4 Describe errors in mitosis.

Text Book Page # 93

(SGD 2014)

Ans:

#### ERRORS IN MITOSIS

Errors in the control of mitosis may cause cancer.

#### Tumor Development:

All cells have genes that control the timing and number of mitosis. Sometimes mutations occur in such genes and cells continue to divide. It results in growth of abnormal cells called tumors.

There are following types of tumors.

(i) **Benign Tumors:**

As long as tumors remain in their original locations, they are called benign tumors.

(ii) **Malignant Tumors:**

If tumors start to invade other tissues, they are called malignant or cancerous tumors, and their cells are called cancer cells.

#### Metastasis:

Malignant tumors can send cancer cells to other body parts where new tumors may form. This phenomenon is called metastasis (spreading of disease).

**Q.5 Define Meiosis and describe its different phases.**

**Text Book Page # 95+96+97+98+99 (FSD 2014)**

**Ans:**

### **MEIOSIS**

#### **Meaning:**

The word meiosis comes from Greek word 'Meioun' meaning "to make smaller" since it results in a reduction in chromosome number.

#### **Definition:**

The process by which one diploid (2n) eukaryotic cell divides to generate four haploid (1n) daughter cells is called meiosis.

#### **Discovery:**

Meiosis was discovered and described for the first time in 1876, by a German biologist Oscar Hertwig.

### **PHASES OF MEIOSIS**

#### **Interphase:**

The preparatory steps of meiosis are identical to the interphase of mitosis. It is divided into the same three phases i.e. G1, S, and G2. Interphase is followed by Meiosis I and Meiosis II.

### **MEIOSIS I**

In meiosis I, the homologous chromosomes in a diploid cell separate and two haploid daughter cells are produced. It is the step in meiosis that generates genetic variations.

#### **Steps:**

Meiosis I occurs in two main steps:

1. Karyokinesis
2. Cytokinesis

### **KARYOKINESIS**

It is divided into:

- (i) Prophase I
- (ii) Metaphase I
- (iii) Anaphase I
- (iv) Telophase I

### **PROPHASE I**

It is the longest phase in meiosis.

#### **Chromosomes:**

During this stage, chromatin condenses into chromosomes.

#### **Synapsis:**

The homologous chromosomes line up with each other and form pairs by a process called synapsis.

#### **Bivalent:**

Each pair of homologous chromosomes is called bivalent.

#### **Tetrad:**

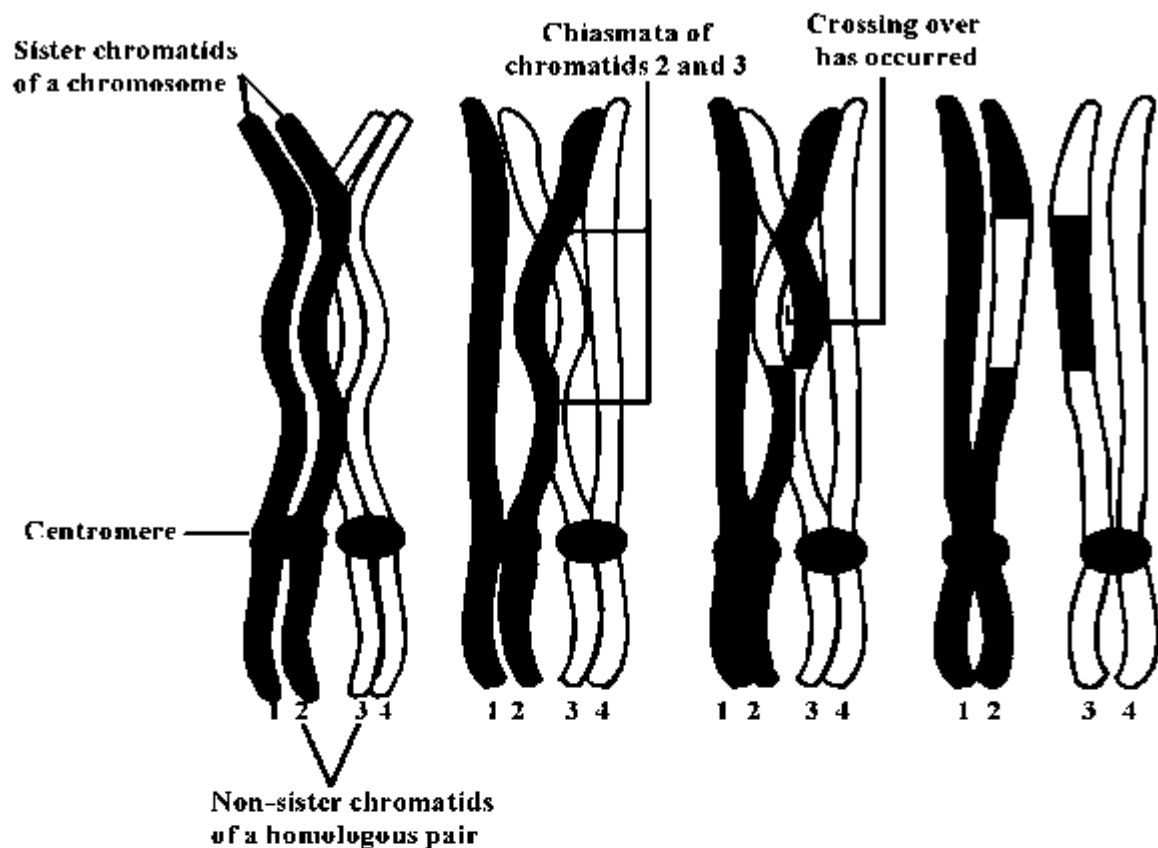
Each bivalent has four chromatids, so it is also called as tetrad.

#### **Chiasmata Formation:**

The two non-sister chromatids of homologous chromosomes join each other at certain points along their length. These points of attachment are called chiasmata.

#### **Crossing-Over:**

The non-sister chromatids of homologous chromosomes exchange their segments. This phenomenon is known as crossing over.



**Figure: Crossing Over**

**Significance of Crossing Over:**

The exchange of segments results in the recombination of genetic information. After crossing over, each pair of homologous chromosomes remains as a bivalent.

**Nuclear Changes:**

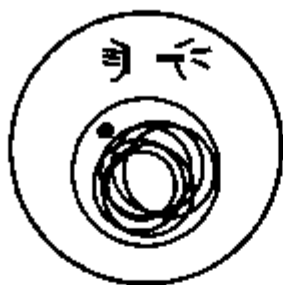
Chromosomes condense further, the nucleoli disappear, and the nuclear envelope disintegrates.

**Spindle Fibres Formation:**

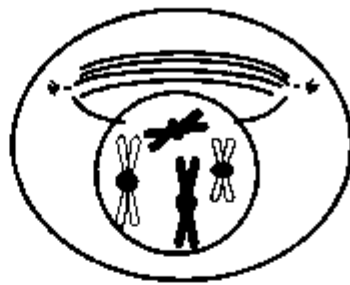
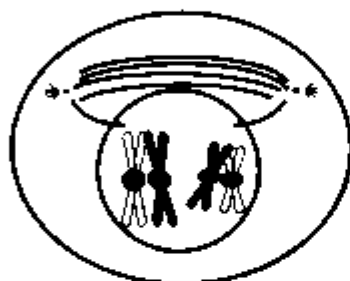
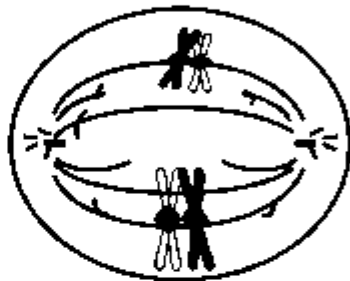
Centrioles, which were duplicated during interphase, migrate to the two poles and give rise to spindle fibres.

**Kinetochores Fibres:**

The kinetochore spindle fibres attach with the kinetochore of chromosomes. While the non-kinetochore spindle fibres from both sides interact with each other. Two kinetochore spindle fibres (from the opposite poles) attach to a pair of chromosomes. In mitosis, two kinetochore spindle fibres attach with one chromosome.

**INTERPHASE**

Chromatin and a Centrosome

**PROPHASE I**Chromatin condenses  
Spindle Formation**PROPHASE I**Chiasmata Formation  
Crossing Over**METAPHASE I**

Formation of Metaphase Plate

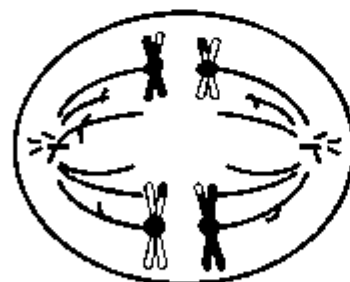
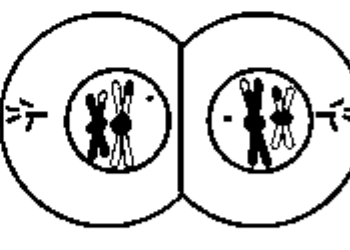
**ANAPHASE I**Chiasmata Break  
Chromosomes Pulled**TELOPHASE I**Each Daughter Cell has  
Haploid no. of Chromosomes

Figure: Stages in Meiosis-I



### **METAPHASE I**

#### **Formation of Metaphase-plate**

The pairs of homologous chromosomes align along the equatorial plane forming the metaphase plate.

### **ANAPHASE I**

#### **Separation of Diploid Chromosomes:**

Kinetochores spindle fibres shorten. It results in pulling apart the chromosomes of each pair. Since one chromosome is pulled toward one pole, two haploid sets are formed. Each chromosome still contains a pair of sister chromatids.

### **TELOPHASE I**

Chromosomes arrive at the poles. Each pole now has half the number of chromosomes, but each chromosome still consists of two chromatids. Spindle network disappears and nuclear envelope is formed around each set. Chromosomes uncoil back into chromatin.

### **CYTOKINESIS**

Cytokinesis, (the pinching of cell membrane in animal cells or the formation of cell wall in plant cells) occurs and the creation of two haploid daughter cells is completed.

### **INTERKINESIS OR INTERPHASE II**

After meiosis I, both haploid daughter cells enter a period of rest, known as interkinesis or interphase II.

#### **Difference:**

The interphase II is different from interphase of mitosis and meiosis I. There is no S Phase and so there is no duplication of chromosomes during this stage.

It is the second part of meiosis, and is similar to mitosis.

### **MEIOSIS II**

#### **Phases of Meiosis II:**

It is divided into:

- (i) Prophase II
- (ii) Metaphase II
- (iii) Anaphase II
- (iv) Telophase II

### **PROPHASE II**

It takes much less time compared to Prophase I. In this prophase, nucleoli and nuclear envelope disappear and chromatin condenses. Centrioles move to the polar regions and make spindle fibres.

### **METAPHASE II**

Chromosomes attach with kinetochores spindle fibres and align at the equator of the cell.

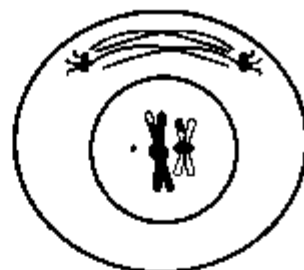
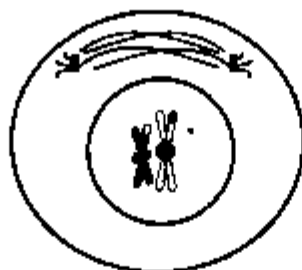
### **ANAPHASE II**

Centromeres are cleaved and sister chromatids are pulled apart. The sister chromatids are now called sister chromosomes, and they are pulled towards opposing poles.

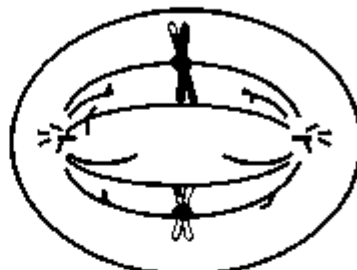
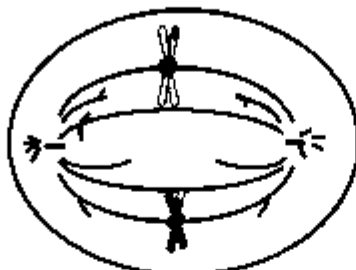
### **TELOPHASE II**

It is marked with uncoiling of chromosomes into chromatin. Nuclear envelopes reform.

PROPHASE II



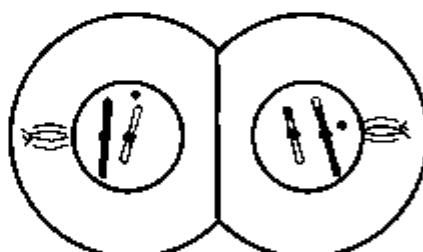
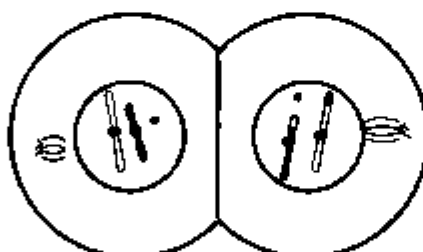
METAPHASE II



ANAPHASE II



TELOPHASE II



DAUGHTER CELLS

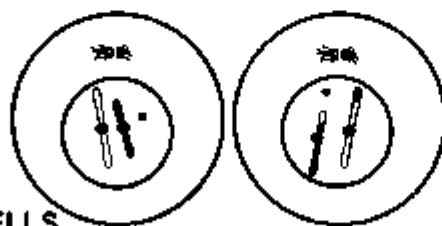


Figure: Stages in Meiosis-II

**Cytokinesis:**

Cleavage or cell wall formation eventually produces a total of 4 daughter cells, each with a haploid set of chromosomes.

**Q.6 Describe significance of meiosis.**

**Text Book Page # 100**

**(LIIR 2014), (GRW 2014), (SWL 2014, 2015), (BWP 2015), (SGD 2014)**

**Ans:**

**SIGNIFICANCE OF MEIOSIS**

**Role of August Weismann:**

The significance of meiosis for reproduction and inheritance was described in 1890 by a German biologist August Weismann. He pointed out that:

“Meiosis was necessary not only to maintain the number of chromosomes in the next generation, but also to produce variations in the next generation.”

**Maintenance Of Chromosome Number In Next Generation:**

Meiosis is essential for sexual reproduction.

**In Humans:**

In humans, diploid gamete mother cells or germ line cells undergo meiosis to produce haploid gametes. Male and female gametes unite to form a diploid zygote, which undergoes repeated mitosis and develops into a new human.

**Fungi and Protozoans:**

Many haploid fungi and protozoans produce haploid gametes through mitosis.

**In Plants:**

Plants' life cycle shows alternation of generations.

- The cells of diploid sporophyte generation undergo meiosis to produce haploid spores.
- The spores grow into haploid gametophyte generation.
- Gametophyte generation produces haploid gametes through mitosis.
- The gametes combine to produce diploid zygote. Zygote undergoes repeated mitosis to become a diploid sporophyte.

**Production of Variations in Next Generations:**

The chromosome pairs of each parent undergo crossing over during meiosis. So daughter cells, i.e gametes, have genetic variations. When gametes fuse to form a zygote, its genetic makeup is different from both the parents. Thus, meiosis allows a species to bring variations in the next generations.

**Adaptation:**

Beneficial variations help organisms to adapt better to the changes in the environment.

**Q.7 Describe errors in meiosis.**

**Ans:**

**ERRORS IN MEIOSIS**

**Disjunction:**

During Anaphase I, chromosomes separate and go to opposite poles, while during anaphase II, sister chromosomes separate. This is called 'Disjunction'.



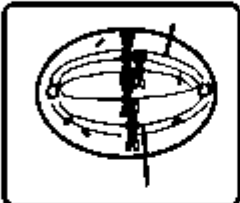
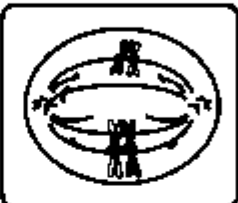
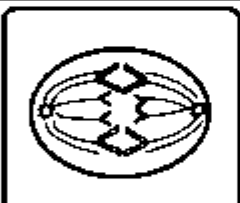

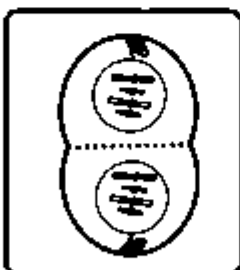
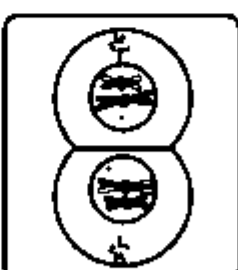
**Non-disjunction:**

Sometimes the separation of chromosomes or is not normal and it is called as 'Non-disjunction'. Non-disjunction results in the production of gametes which have either more or less than the normal number of chromosomes. If such an abnormal gamete fuses with a normal gamete, it results in an abnormal number of chromosomes in the next generation, for example 45 or 47 chromosomes in humans.

**Q.8 Give a comparison between mitosis and meiosis. Text Book Page # 101**  
**(BWP 2014), (DGK 2015), (SGD 2015)**

**Ans:**

**COMPARISON**

MITOSIS	MEIOSIS
 <p><b>PROPHASE</b></p> <ul style="list-style-type: none"> <li>Homologous chromosomes do not form pairs. There is no crossing over.</li> </ul>	 <p><b>PROPHASE I</b></p> <ul style="list-style-type: none"> <li>In prophase I, there is pairing of chromosomes and crossing over between homologous chromosomes.</li> </ul>
 <p><b>METAPHASE</b></p> <ul style="list-style-type: none"> <li>Single chromosomes align to form metaphase plate.</li> </ul>	 <p><b>METAPHASE I</b></p> <ul style="list-style-type: none"> <li>Homologous pairs align to form metaphase plate.</li> </ul>
 <p><b>ANAPHASE</b></p> <ul style="list-style-type: none"> <li>Chromosomes break and individual chromatids are pulled towards poles.</li> </ul>	 <p><b>ANAPHASE I</b></p> <ul style="list-style-type: none"> <li>Individual chromosomes are pulled towards poles.</li> </ul>
 <p><b>DAUGHTER CELLS</b></p> <ul style="list-style-type: none"> <li>Daughter nuclei contain diploid number of chromosomes.</li> <li>Each chromosome has single chromatid.</li> </ul>	 <p><b>DAUGHTER CELLS</b></p> <ul style="list-style-type: none"> <li>Daughter nuclei contain haploid number of chromosomes.</li> <li>Each chromosome has two chromatids.</li> </ul>

**Q.9 Write a note on apoptosis.**

**Text Book Page # 102**

**(GRW 2012, 2013), (LHR 2014, 2016), (SWL 2014), (RWP 2015)**

**Ans:**

**APOPTOSIS**

**Definition:**

The type of cell death which is well-programmed and regulated is called apoptosis.

**Rate of Apoptosis:**

In an adult human, 50 to 70 billion cells die by apoptosis each day.

**MECHANISM**

**Break Down Of Cytoskeleton:**

During Apoptosis, cell shrinks and becomes rounded due to the breakdown of cytoskeleton by enzymes.

**Degradation of Nucleus:**

Chromatin undergoes condensation and nuclear envelope breaks. In this way, nucleus spreads in the form of several discrete chromatin bodies.

**Blebs:**

Cell membrane makes irregular buds called blebs.

**Apoptotic Bodies:**

Blebs break off from the cell and are now called apoptotic bodies.

**Phagocytosis:**

These apoptotic bodies are then phagocytosed by other cells.

**SIGNIFICANCE OF APOPTOSIS**

- Apoptosis can occur when a cell is damaged or under go stress conditions. Apoptosis removes the damaged cell, preventing it from getting further nutrients.
- Apoptosis prevents the spread of infection.
- Apoptosis also gives advantages during development. For example, during the formation of fingers, the cells between them undergo apoptosis and the digits separate.

**Q.10 Write a note on necrosis.**

**Text Book Page # 103 (LHR 2012), (SWL 2015)**

**Ans:**

**NECROSIS**

**Definition:**

The accidental death of cells and living tissues is called necrosis.

**Difference from Apoptosis:**

Necrosis is less sequential than apoptosis.

**Causes of Necrosis:**

There are many causes of necrosis, including:

- Injury
- Infection
- Cancer
- Hypoxic environment
- Lack of proper care to a wound site
- Spider bites

**MECHANISM**

During necrosis, there is a release of special enzymes from lysosomes. Lysosomal enzymes break cellular components and may also be released outside the cell to break the surrounding

cell. The cells that die by necrosis may also release harmful chemicals that damage other cells.

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## Unit 6: Enzymes

### Short Questions

#### 1. Define Metabolism.

Text Book Page # 107 (LHR 2012, GRW 2015, SWL 2014)

**Ans: Meaning:**

The term metabolism is derived from a Greek word meaning "Change".

**Definition:**

"Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life".

- These processes allow organisms to grow and reproduce, maintain their structure, and respond to their environments.

#### 2. Who gave the concept of Metabolism?

(SWL 2015)

**Ans:** The concept of metabolism was first of all given by Ibn-e-Nafees, who stated that, "The body and its parts are always undergoing change."

#### 3. What is the difference between catabolism and Anabolism?

(LHR 2014, 2016, DGK 2015, BWP 2015, SGD 2014, 2015, RWP 2015)

**Ans:**

CATABOLISM	ANABOLISM
<ul style="list-style-type: none"><li>• Catabolism includes the biochemical reactions in which larger molecules are broken down.</li><li>• Energy is released in catabolism.</li></ul> <p><b>Example:</b> Cellular respiration</p>	<ul style="list-style-type: none"><li>• Anabolism includes the biochemical reactions in which larger molecules are synthesized.</li><li>• Energy is utilized in anabolism.</li></ul> <p><b>Example:</b> Photosynthesis</p>

#### 4. What are enzymes?

**Ans:** "Enzymes are proteins that catalyze (i.e. speed up) biochemical reactions and are not changed during the reaction."

During metabolism, chemicals are transformed from one form to the other by enzymes. Enzymes are crucial to metabolism because they act as biocatalysts and speed up and regulate metabolic pathway.

#### 5. What is the difference between substrate and product?

(LHR 2013, GRW 2013, LHR 2014)



**Ans:** The molecules at which enzymes act are called substrates, and enzyme converts them into different molecules, called products.

**6. Define Activation Energy.**

(LHR 2015, BWP 2015)

**Ans: Definition:**

“The minimum amount of energy required to start the biochemical reaction is called activation energy”.

**Need:**

The need for activation energy acts as a barrier to the beginning of reaction. Enzymes lower such barriers by decreasing the requirement of activation energy

**7. How do enzymes lower activation energy?**

(MTN 2014, 2015, SWL 2015, FSD 2014, 2015)

**Ans:** Enzymes lower the activation energy in several ways:

- They may alter the shape of substrate and reduce the requirement of energy for this change.
- Some enzymes do so by disrupting the charge distribution on substrates.
- Enzymes also lower activation energy by bringing substrate in correct orientation to react.

**8. Differentiate between intracellular and extracellular enzymes. Text Book Page # 108**

(GRW 2015, MTN 2015)

**Ans:** Enzymes can be categorized on the basis of the site where they work i.e. they may be intracellular enzymes (e.g. enzymes of glycolysis working in the cytoplasm) or may be extracellular enzymes (e.g. pepsin enzyme working in the stomach cavity)

**9. Illustrate with the help of Diagram that enzymes lower activation energy.**

**Ans:**

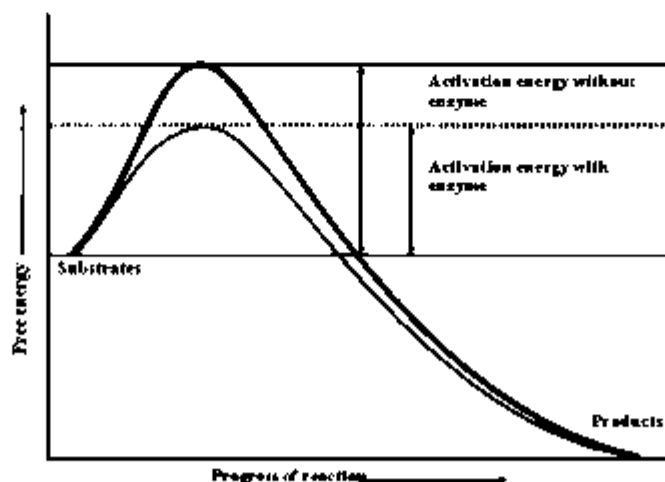


Figure: Enzymes Lower the Activation Energy

**10. Who first used the term enzyme?**

(LHR 2015)

**Ans:** In 1878, German Physiologist Winhelm Kuhne first used the term Enzyme

**11. Write down the two characteristics of enzymes? (LHR 2016, SGD 2015)**

**Ans:**

- Almost all enzymes are proteins i.e. they are made of amino acids.
- Enzymes are usually very specific for the type of reaction and for the nature of their substrates.

**12. Define Active Site.**

**Text Book Page # 109**

**(LHR, GRW 2015, SWL 2014)**

**Ans:** "Only a small portion of enzyme molecule is directly involved in catalysis. This catalytic region is known as active site".

- It recognizes and binds substrate and then carries out reaction.

**13. What are co-factors?**

**(GRW 2014, 2015)**

**Ans:** "Some enzymes do not need any additional components to work. However, others require some components which are called Co-factors".

- Co-factors are non-protein molecules or ions. Cofactors can be Inorganic (e.g. Metal ions) and Organic (e.g. Flavin & Heme)

**14. Write difference between cofactors and coenzymes.**

**(SWL 2015, MTN 2015, DGK 2015, SGD 2015)**

**Ans:**

COFACTORS	COENZYMES
<ul style="list-style-type: none"> <li>• Some enzymes need some components which are called cofactors.</li> <li>• Cofactors are non-proteins molecules or ions.</li> <li>• Cofactors can be either inorganic (e.g. Metal ions) or organic e.g. Flavin or heme.</li> </ul>	<ul style="list-style-type: none"> <li>• If organic cofactors are loosely attached with enzymes. They are called Coenzymes.</li> <li>• Coenzymes transport chemical groups from one enzyme to another.</li> <li>• Some important vitamins (e.g. riboflavin, thiamine and folic acid) act as coenzymes.</li> </ul>

**15. What is the difference between prosthetic group and co-enzymes?**

**(LHR 2014, GRW 2015)**

**Ans:** Cofactors can be of two types:

**i. Prosthetic Groups:**

"If the organic cofactors are tightly bound to enzyme, they are called prosthetic groups."

**Example:**

Heme

**ii. Co-enzymes:**

“If the organic cofactors are loosely attached with enzyme, they are called coenzymes”.  
Coenzymes transport chemical groups from one enzyme to the other.  
Some important vitamins act as coenzymes e.g.,

- Riboflavin
- Thiamine
- Folic acid

**16. Name the vitamins which act as coenzymes.**

**(MTN 2015)**

**Ans:** Following are some important vitamins which act as coenzymes.

- Riboflavin
- Thiamine
- Folic Acid

**17. Give any two uses of enzymes. / What is the main use of enzymes in food industry?**

**(LHR, GRW 2013, 2014, 2016, MTN 2015, SGD 2014, 2015, RWP 2014)**

**Ans:** Enzymes are extensively used in different industries for fast chemical reactions.

**(i) Food Industry:**

Enzymes that break starch into simple sugars are used in the production of:

- White bread
- Buns

**(ii) Brewing Industry:**

Enzymes break starch and proteins. The products are used by yeast for fermentation to produce alcohol.

**18. Name only factors affecting the rate of enzyme action.** **(LIIR 2015, RWP 2014)**

**Ans:** Following are the names of some important factors which affect the rate of enzyme action.

- Temperature
- Substrate concentration
- pH

**19. Define Optimum temperature.**

**Text Book Page # 110 (LHR 2014, 2016, SGD 2015, RWP 2015)**

**Ans:** "Every enzyme works at its maximum rate at a specific temperature which is called optimum temperature for that enzyme."

- The optimum temperature for maximum working speed of enzymes in human body is 37°C.

**20. What do you mean by denaturation of enzyme? How temperature affects rate of enzymes reaction?** **(LIIR 2013, 2016, GRW 2014, 2015, DGK 2014)**

**Ans:** When temperature rises to a certain limit, heat adds in the activation energy and also provides kinetic energy for the reaction. So the reactions are accelerated. But when the temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of

enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

- Denaturation results in a rapid decrease in rate of enzyme action and it may be blocked completely.

21. Birds have higher body temperature than mammals. What would happen to activity of a bird's enzyme if it is given temperature of  $37^{\circ}\text{C}$ ?

Ans: If a bird is given temperature of  $37^{\circ}\text{C}$ , the reaction rate will slow down as the bird's body have higher temperature than mammals.

22. What would happen to reaction if enzyme concentration is kept constant and amount of substrate is increased? (SGD 2014)

Ans: If enzyme concentration is kept constant, and the amount of substrate is increased, a point is reached where any further increase in the substrate does not increase the rate of reaction any more.

**Saturation:**

When the active sites of all enzymes are occupied, at high substrate concentrations, any more substrate molecules do not find free active sites. This state is called saturation of active sites and reaction rate does not increase.

23. Draw a diagram showing effects of substrate concentration on enzyme activity.

Text Book Page # 111

Ans:

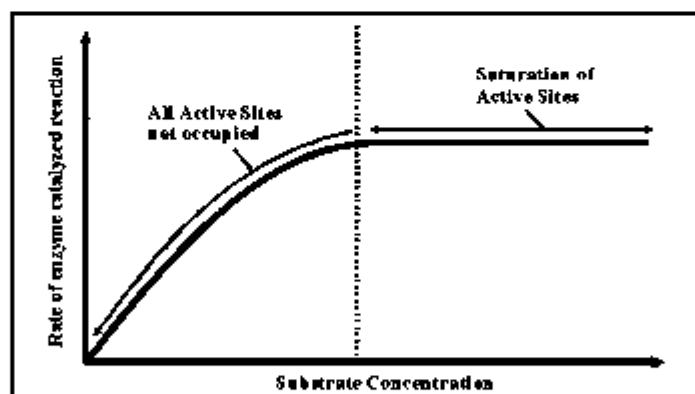


Figure: Effect of Substrate Concentration on Enzyme Activity

24. Define optimum pH. How does pH affect enzyme activity?

(GRW 2012, LIIR 2014, DGK 2014, 2015)

Ans: "All enzymes work at their maximum rate in a narrow range of pH, called as the optimum pH".

Every enzyme has its specific optimum pH value.

**Effect of pH Change:**

A slight change in optimum pH of an enzyme causes retardation in enzyme activity or blocks it completely. Change in pH can effect the ionization of amino acids at the active site.

**25. Describe lock and key model for enzyme action. Text Book Page # 112**

**(LHR 2012, GRW 2013, 2014, SWL 2014, MTN 2014, SWL 2015, DGK 2015, FSD 2014)**

**Ans:** In order to explain the mechanism of enzyme action, a German chemist Emil Fischer in 1894, proposed 'Lock and Key Model' for enzyme action.

**Model:**

According to this model:

"Both enzyme and substrate possess specific shapes that fit exactly into one another".

**Enzyme Specificity:**

This model explains enzyme specificity for its substrates.

**26. What is induced fit model?**

**(SWL 2014), (DGK 2014), (MTN 2015), (BWP 2015), (SGD 2014), (RWP 2015)**

**Ans:** In 1958, an American biologist Daniel Koshland suggested a modification to Lock and Key model and proposed 'Induced-fit model'.

**Model:**

According to this model,

"The active site is not a rigid structure rather it is molded into the required shape to perform its function."

**Advantage:**

This model is more acceptable than Lock and Key Model.

**27. How specificity of enzymes is determined?**

**Ans:** Specificity of different enzymes is determined by the shapes of their active sites. Active sites possess specific geometric shapes that fit with specific substrates.

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## Unit 6: Enzymes

### Multiple Choice Questions

- The term metabolism is derived from: Text Book page#107 (LHR 2012, SWL 2015)  
(a) Greek word (b) Latin Word  
(c) Italian word (d) French word
- The term Metabolism is derived from the Greek words means:  
(FSD 2014, BWL 2014)  
(a) Split (b) Change  
(c) Division (d) Break
- The concept of metabolism was first of all given by:  
(a) Ibn-e-Nafees (b) Winhelm Kuhne  
(c) Emil Fischer (d) Daniel Koshland
- Which of the following is not true about enzymes?  
(a) They act as biocatalysts (b) Enzymes speed up biochemical reactions  
(c) They lower the activation energy (d) They increase the activation energy
- Chemically enzymes are: (LHR 2016)  
(a) Protein (b) Carbohydrates  
(c) Lipids (d) Fats
- To which group of molecules enzymes belong?  
(GRW 2013, 2014, GRW 2013, MTN 2013, LHR 2013, 2015)  
(a) Carbohydrates (b) Proteins  
(c) Nucleic acids (d) Lipids
- The molecules on which enzymes act are called: (DGK 2014, SWL 2014, GRW 2012)  
(a) Substrates (b) Co-enzyme  
(c) Proteins (d) Enzyme substrates complex
- Enzymes lower the activation energy in the ways:  
(a) They may alter the shape of substrate  
(b) Some enzymes do so by disrupting the charge distribution on substrates  
(c) They may lower activation energy by bringing substrates in the correct orientation to react  
(d) All of these
- Almost all the enzymes are: (DGK 2014, 2015)  
(a) Vitamins (b) Protein  
(c) Carbohydrates (d) Fats
- When the term enzyme was used for the first time? Text Book page#108  
(a) 1874 (b) 1876  
(c) 1878 (d) 1880
- Who first time used the term enzyme? (SGD 2014, GRW 2015)  
(a) Winhelm Kuhne (b) Daniel Koshland  
(c) Emil Fischer (d) Ibn-e-Nafees
- The catalytic region of enzyme is called: Text Book page#109 (BWP 2015)  
(a) Cofactor (b) Coenzyme

- (c) Prosthetic group (d) Active site
13. If organic cofactors are tightly bound to enzyme, they are called:  
 (a) Coenzymes (b) Prosthetic groups  
 (c) Both a & b (d) None of these
14. If organic cofactors are loosely attached with enzyme, they are called:  
 (a) Coenzymes (b) Prosthetic groups  
 (c) Both a & b (d) None of these
15. Which one is an organic cofactor?  
 (a) Flavin (b) Heme  
 (c) Both a & b (d) None of these
16. Which of the following vitamins act as coenzyme? (LHR 2013)  
 (a) Riboflavin (b) Thiamine  
 (c) Folic acid (d) All of these
17. The enzymes used for the removal of protein stains from clothes?  
 (LHR 2012, SWL 2015)  
 (a) Protease (b) Amylase  
 (c) Lipase (d) All of these
18. Which enzymes are used in dish washing to remove resistant starch residues?  
 (LHR 2012)  
 (a) Protease (b) Amylase  
 (c) Lipase (d) All of these
19. The optimum temperature for the maximum working speed of human enzymes is:  
 Text Book page#110 (FSD 2015, MTN 2015, RWP 2015)  
 (a) 35°C (b) 37°C  
 (c) 39°C (d) 43°C
20. When there is an increase in temperature, the rate of enzyme catalyzed reactions:  
 (a) Increases (b) Decreases  
 (c) Remains constant (d) All of these
21. Number of discovered enzymes so far: Text Book page#112  
 (a) 1000 (b) 1500  
 (c) 2000 (d) 2500
22. Who proposed lock and key model? (BWP 2015, MTN 2014)  
 (a) Winhelm Kuhne (b) Daniel Koshland  
 (c) Emil Fischer (d) Ibn-e-Nafees
23. Who proposed induced-fit model? (SGD 2015)  
 (a) Winhelm Kuhne (b) Ibn-e-Nafees  
 (c) Emil Fischer (d) Daniel Koshland
24. When was lock and key model proposed? (DGK 2015, GRW 2012)  
 (a) 1894 (b) 1896  
 (c) 1898 (d) 1890
25. When was induced-fit model proposed? (GRW 2015)  
 (a) 1952 (b) 1954  
 (c) 1956 (d) 1958
26. Which of the following is not true about induced fit model?  
 (a) This model explains specificity of enzymes



- (b) It is more acceptable model  
 (c) According to this model active site is not rigid structure  
 (d) Active site is molded into the required shape.
27. Starch is broken down by an enzyme called: (SGD 2014, LIIR 2014)  
 (a) Lipase (b) Pepsin  
 (c) Amylase (d) All of these
28. The enzyme that acts on lipids: (SGD 2015, RWL 2014, SWL 2014)  
 (a) Protease (b) Lipase  
 (c) Amylase (d) Pepsin
29. The peptide bonds in proteins are broken down by:  
 (a) Protease (b) Lipase  
 (c) Amylase (d) All of these

#### ANSWERS KEY

1	a	11	a	21	c
2	b	12	d	22	c
3	a	13	b	23	d
4	d	14	a	24	a
5	a	15	c	25	d
6	b	16	d	26	a
7	a	17	a	27	c
8	d	18	b	28	b
9	b	19	b	29	a
10	c	20	a		

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## **Unit 6: Enzymes**

### **Long Questions**

**Q.1** How can you relate enzymes with metabolism? Also describe Activation Energy.

Text Book Page # 107

**Ans:** **METABOLISM AND ENZYMES**

Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life. These processes allow organisms to grow and reproduce, maintain their structure, and respond to their environments.

**Anabolism:**

Anabolism includes the biochemical reactions in which larger molecules are synthesized. Energy is utilized in anabolism.

**Catabolism:**

Catabolism includes the biochemical reactions in which larger molecules are broken down. Usually, energy is released in catabolism.

**Energy Transfer:**

The biochemical reactions are actually energy transfers.

**Enzymes:**

During metabolism, chemicals are transformed from one form to the other by enzymes. Enzymes are crucial to metabolism because they act as biocatalysts and speed up and regulate metabolic pathway.

Enzymes are proteins that catalyze (i.e. speed up) biochemical reactions and are not changed during the reaction.

**Substrate:**

The molecules at which enzymes act are called substrates.

**Products:**

Enzyme converts them into different molecules, called products.

#### **ACTIVATION ENERGY**

**Definition:**

The minimum amount of energy required to start the biochemical reaction is called activation energy.

**Need:**

The need for activation energy acts as a barrier to the beginning of reaction. Enzymes lower such barriers by decreasing the requirement of activation energy.

**Lowering of Activation Energy:**

Enzymes lower the activation energy in several ways:

- They may alter the shape of substrate and reduce the requirement of energy for this change.
- Some enzymes do so by disrupting the charge distribution on substrates.

- Enzymes also lower activation energy by bringing substrate in correct orientation to react.

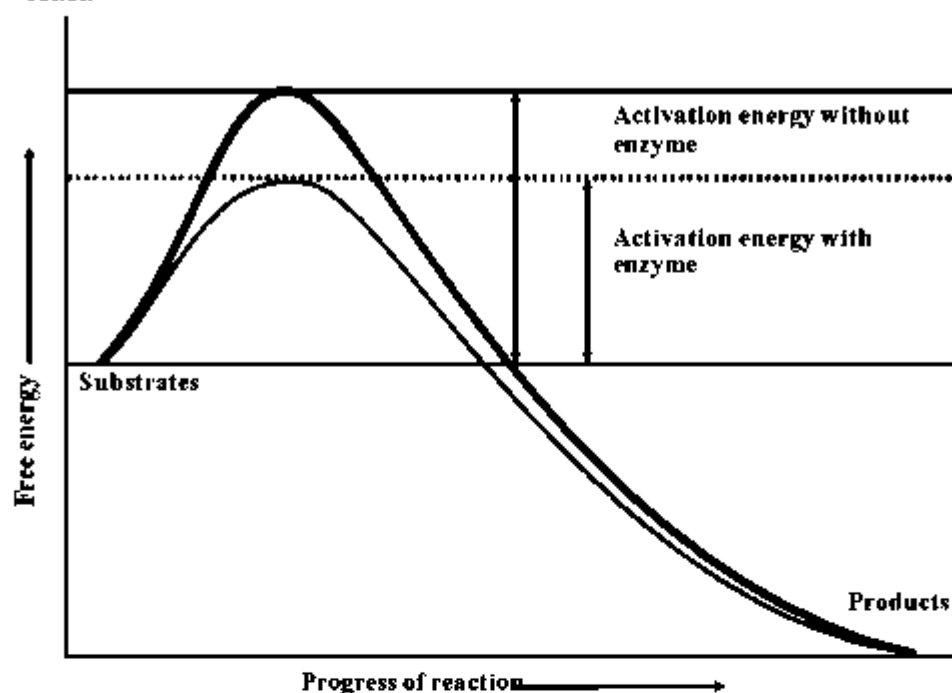


Figure: Enzymes Lower the Activation Energy

**Q.2 Describe the characteristics of enzymes.**

Text Book Page # 108+109 (LHR 2012) (LHR 2013) (GWR 2013) (GWR 2015) (DGK 2014) (MTN 2015) (DGK 2015) (BWP 2015) (SGD 2014)

Ans:

#### CHARACTERISTICS OF ENZYMES

(i) **Introduction:**

In 1878, German Physiologist Winhelm Kuhne first used the term Enzyme.

(ii) **Biochemical Nature:**

Enzymes are globular proteins. Like all proteins, they are made up of long, linear chains of amino acids that fold to produce a three-dimensional molecule.

(iii) **Rates of Reaction:**

Most enzyme reaction rates are millions of times faster than those of comparable uncatalyzed reactions. As with all catalysts, enzymes are not consumed by the reactions they catalyze.

(iv) **Specificity:**

Enzymes are usually very specific for the type of reaction and for the nature of their substrates.

(v) **Active Site:**

Only a small portion of enzyme molecule is directly involved in catalysis. This catalytic region is known as active site. It recognizes and binds substrate and then carries out reaction.

**(vi) Regulation of Enzyme Activity:**

Enzyme production can be enhanced or diminished by a cell according to needs. Enzyme activity can also be regulated by inhibitors and activators.

**(vii) Need for Co-Factors:**

Some enzymes do not need any additional components to work. However, others require some components which are called 'Co-factors'.

Co-factors are non-protein molecules or ions. Cofactors can be Inorganic (e.g. Metal ions) and Organic (e.g. Flavin & Heme)

**Types of Cofactors:**

Cofactors can be of two types:

**(a) Prosthetic Groups:**

If the organic cofactors are tightly bound to enzyme, they are called prosthetic groups.

**(b) Co-enzymes:**

If the organic cofactors are loosely attached with enzyme, they are called coenzymes.

Coenzymes transport chemical groups from one enzyme to the other.

Some important vitamins act as coenzymes e.g.,

- Riboflavin
- Thiamine
- Folic acid

**Regulation of Metabolic Pathways:**

Several enzymes can work together in a specific order, creating metabolic pathways. In a metabolic pathway, one enzyme takes the product of another enzyme as a substrate. After the reaction, the product is passed on to the next enzyme.

**Q.3 Describe the uses of enzymes.**

Text Book Page # 109

(LHR 2012) (LHR 2014) (DGK 2014-15) (SGD 2015) (RWP 2015)

**Ans:**

**USES OF ENZYMES**

Enzymes are extensively used in different industries for fast chemical reactions. For example;

**(i) Food Industry:**

Enzymes that break starch into simple sugars are used in the production of:

- White bread
- Buns

**(ii) Brewing Industry:**

Enzymes break starch and proteins. The products are used by yeast for fermentation to produce alcohol.

**(iii) Paper Industry:**

Enzymes break starch to lower its viscosity, which aids in making paper.

**(iv) Biological Detergent:**

- Protease enzymes are used for the removal of protein stains from clothes.
- Amylase enzymes are used in dish washing to remove resistant starch residues.

**Q.4 Describe in detail the factors that affect the rate of enzyme action.**

**Text Book Page # 110+111 (BWP 2014) (SGD 2014) (RWP 2015)**

**Ans:**

**FACTORS**

Enzymes are very sensitive to the environment in which they work. Any factor that can change the chemistry or shape of enzyme molecule, can affect its activity. Some of such factors are as follow:

- (i) Temperature
- (ii) Substrate concentration
- (iii) pH

**TEMPERATURE**

**(GRW 2012)**

**Effect:**

Increase in temperature speeds up the rate of enzyme-catalyzed reactions, but only up to a point.

**Optimum Temperature:**

Every enzyme works at its maximum rate at a specific temperature which is called optimum temperature for that enzyme.

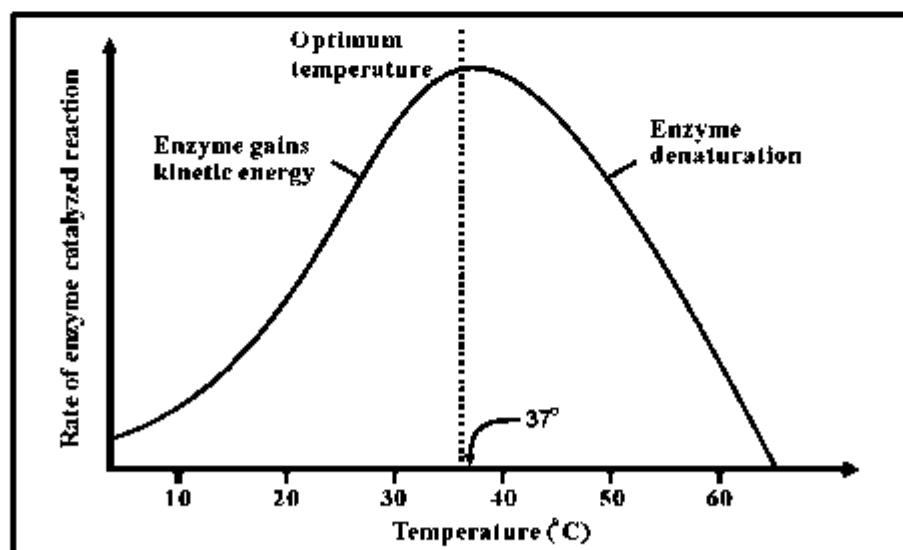
**Denaturation:**

When temperature rises to a certain limit, heat adds in the activation energy and also provides kinetic energy for the reaction. So the reactions are accelerated. But when the temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

Denaturation results in a rapid decrease in rate of enzyme action and it may be blocked completely.

**Example:**

The optimum temperature for maximum working speed of enzymes in human body is 37°C.



**Figure: Effect of Temperature on Enzyme Activity**

**SUBSTRATE CONCENTRATION (LHR 2014)**

**Increase in Substrate Concentration:**

If enzyme molecules are available in a reaction, increase in the substrate concentration increases the rate of reaction.

**Constant Enzyme Concentration:**

If enzyme concentration is kept constant, and the amount of substrate is increased, a point is reached where any further increase in the substrate does not increase the rate of reaction any more.

**Saturation:**

When the active sites of all enzymes are occupied, at high substrate concentrations, any more substrate molecules do not find free active sites. This state is called saturation of active sites and reaction rate does not increase.

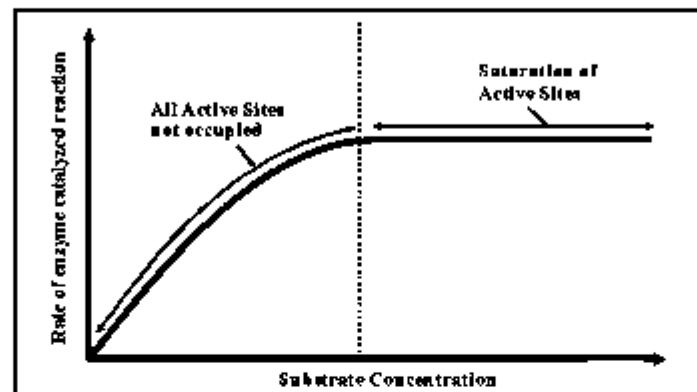


Figure: Effect of Substrate Concentration on Enzyme Activity

**pH**

**Optimum pH:**

All enzymes work at their maximum rate in a narrow range of pH, called as the optimum pH. Every enzyme has its specific optimum pH value.

**Effect of pH Change:**

A slight change in optimum pH of an enzyme causes retardation in enzyme activity or blocks it completely. Change in pH can effect the ionization of amino acids at the active site.

**Examples:**

- Pepsin (working in stomach) is active in acidic medium, i.e. Low pH.
- Trypsin (working in small intestine) shows its activity in alkaline medium i.e. High pH

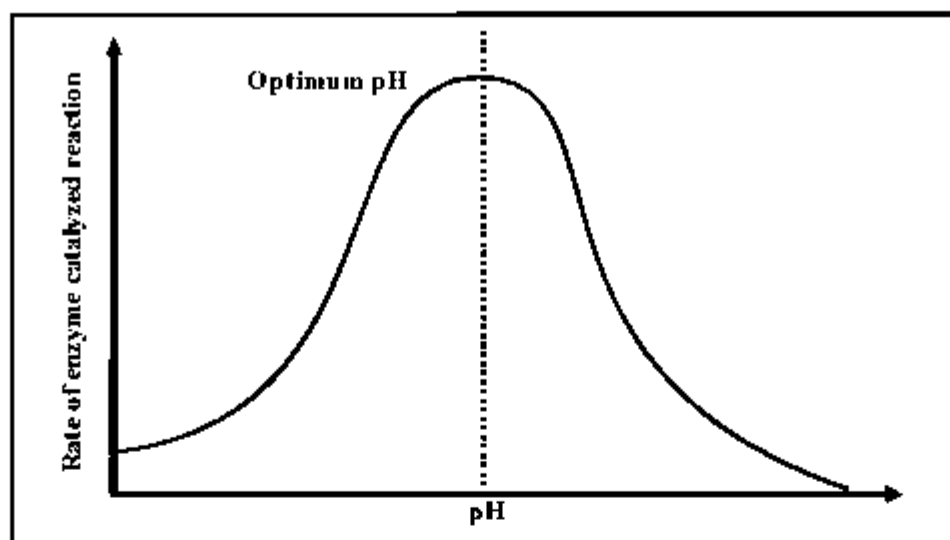


Figure: Effect of pH on Enzyme Activity

**Q.5** Describe mechanism of enzyme action.

Text Book Page # 111+112

(SWL 2014) (GRW 2013) (GRW 2012) (GWR 2014) (IHR 2015) (SWL 2015) (RWP 2015)

Ans:

#### MECHANISM OF ENZYME ACTION

When enzyme attaches with its substrate, a temporary enzyme-substrate (ES) complex is formed. Enzyme catalyzes the reaction and the substrate is transformed into product. After it, the ES complex breaks, and the enzyme and product are released.



#### LOCK AND KEY MODEL (BWP 2015) (SGD 2015)

In order to explain the mechanism of enzyme action, a German chemist Emil Fischer in 1894, proposed 'Lock and Key Model' for enzyme action.

**Model:**

According to this model:

"Both enzyme and substrate possess specific shapes that fit exactly into one another."

**Enzyme Specificity:**

This model explains enzyme specificity for its substrates.

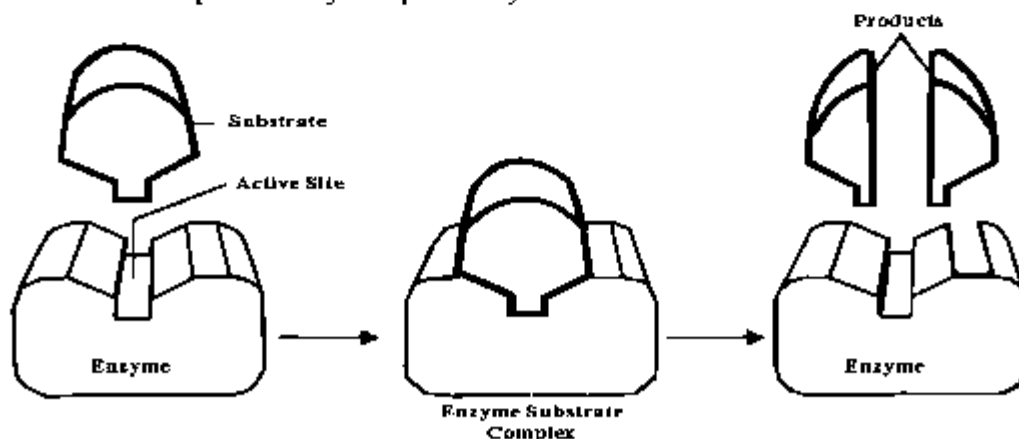


Figure: Lock and Key Model of Enzyme Action



**INDUCED-FIT MODEL** (GWR 2014) (GWR 2015) (MTN 2014)

In 1958, an American biologist Daniel Koshland suggested a modification to Lock and Key model and proposed 'Induced-fit model'.

**Model:**

According to this model,

"The active site is not a rigid structure rather it is molded into the required shape to perform its function."

**Advantage:**

This model is more acceptable than Lock and Key Model.

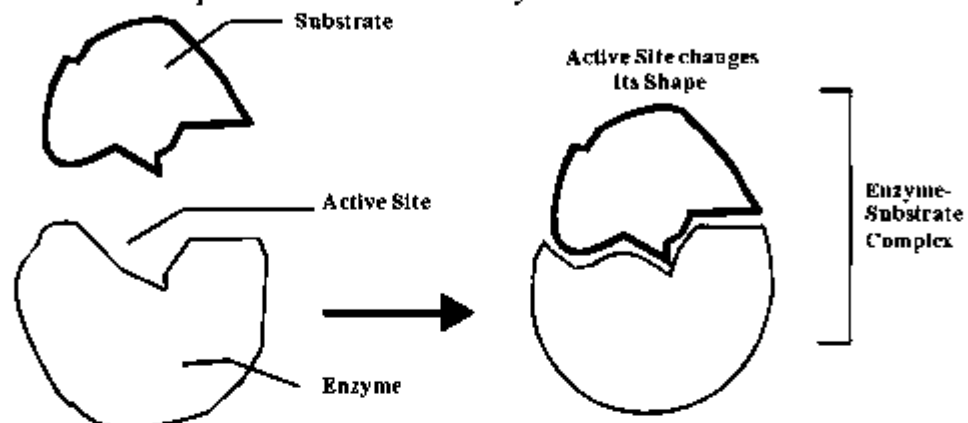


Figure: Induced-Fit Model of Enzyme Action

**Q.6** Explain specificity of enzymes. Text Book Page # 112

(SWL 2015) (FSD 2014) (FSD 2015)

**Ans:**

**SPECIFICITY OF ENZYMES****Number:**

There are over 2000 known enzymes.

**Substrate Specificity:**

Each enzyme is involved in one specific chemical reaction. Enzymes are also substrate specific.

**Examples:**

- **Protease:**

The enzyme protease, which breaks peptide bonds in proteins, will not work on starch.

- **Amylase:**

Starch is broken down by amylase.

- **Lipase:**

Lipase enzyme acts only on lipids and digests them into fatty acids and glycerol.

**Determination of Specificity:**

Specificity of different enzymes is determined by the shapes of their active sites. Active sites possess specific geometric shapes that fit with specific substrates.

**Diagrammatic Presentation:**

In the following diagram, only the substrate 3 will exactly fit in the active site of the enzyme. The substrates 1 and 2 can not fit.

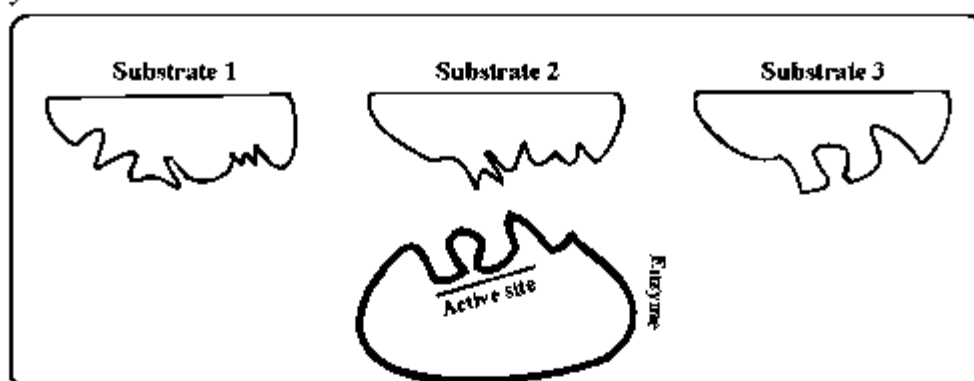


Figure: Specificity of Enzyme due to the Geometric Shape of Active Site

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## Unit 7: Bioenergetics

### Short Questions

1. What are forms of energy in living organism? Or In how many forms does energy exist in living organisms? Text Book Page # 117

**Ans:** In living organisms, energy exists in two forms.

- (i) **Kinetic energy:**

It is involved in doing any work.

- (ii) **Potential energy:**

It is stored energy for future use. Potential energy is stored in chemical bonds and is released as kinetic energy when these bonds break.

2. Define Bioenergetics. (GRW 2012, 2015)

**Ans:** "Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms."

3. Discuss energy transformations in living organisms.

**Ans:** Organisms obtain energy by metabolizing the food they eat or prepare. Food contains potential energy in its bonds. When these bonds are broken down, a large amount of kinetic energy is usually released. Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out life activities.

4. Recall mode of nutrition of Plants, Micro-organisms, fungi and Animals.

**Ans: Plants and Micro-organisms:**

Plants and some micro-organisms (e.g. photosynthetic bacteria and algae) prepare their own food from carbon dioxide and water in the presence of light by a process called photosynthesis.

**Animals and Fungi:**

Animals, fungi and many micro-organisms (non-photosynthetic bacteria and protozoans) get the prepared food.

5. What are redox reactions?

Text Book Page # 118 (LHR 2013, 2014, FSD 2014, BWP 2015)

**Ans:** For all life processes, oxidation-reductions reactions (redox reactions) are the direct source of energy.

**Redox Reactions:**

Redox reactions involve exchange of electrons between atoms.

**Oxidation:**

The loss of electrons is called oxidation.

**Reduction:**

The gain of electrons is called reduction.

**6. Can electrons be an energy source?**

**Ans:** Electrons can be an energy source. It depends upon their location and arrangement in atoms.

**Examples:**

- When electrons are present in oxygen, they make stable association with oxygen atom and are not good energy source.
- If electrons are dragged away from oxygen and attached to some other atom e.g. carbon or hydrogen, they make unstable association. They try to move back to oxygen and when this happens, energy is released.

**7. What is the role of ATP in living organisms?**

**Text Book Page # 119**

**Ans: Significance:**

ATP is the main energy source for majority of the cellular functions like:

- Synthesis of macromolecules (DNA, RNA, proteins)
- Movement
- Transmission of nerve impulses
- Active transport
- Exocytosis
- Endocytosis

**8. Describe structure of ATP.**

**Ans:** The ability of ATP to store and release energy is due to its molecular structure. Each ATP molecule has three subunits:

- (i) Adenine (a double-ringed nitrogenous base)
- (ii) Ribose (a five-carbon sugar)
- (iii) Three phosphate groups in a linear chain

**9. What is meant by cell's energy currency?**

**(SWL 2014, MTN 2014, DGGK 2015)**

**Ans: The Cell's Energy Currency**

The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP). It is the main energy source for majority of the cellular functions like synthesis of macromolecules (DNA, RNA, and proteins), movement, transmission of nerve impulses, active transport, exocytosis and endocytosis etc.

**10. How energy is recycled in a cell?**

**Text Book Page # 120**

**Ans:** Cells constantly recycle ADP by recombining it with  $P_i$  to form ATP. The synthesis of ATP from ADP and  $P_i$  requires the expenditure of 7.3 kcal of energy per mole. This energy is obtained from the oxidation of foodstuff.

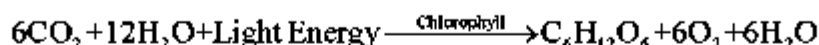
**11. Define photosynthesis. Write down its chemical equation.**

(GRW 2012, 2013, 2014, LHR 2013, 2015, SWL 2014, MTN 2014, BWP 2015, SGD 2014, 2015, RWP 2015)

**Ans: Definition:**

"The process of synthesis of glucose from carbon dioxide and water in the presence of sunlight and chlorophyll, with oxygen as a by-product is called as photosynthesis."

- Photosynthesis is an important anabolic (building) process. It comprises many coordinated biochemical reactions.



**12. How  $\text{CO}_2$  is taken into plants through leaves? Text Book Page # 121**

**Ans:** The air that enters leaf through tiny pores (stomata) reaches into the air spaces present around mesophyll cells. This air carries  $\text{CO}_2$ , which gets absorbed in the thin layer of water surrounding mesophyll cells. From here, the carbon dioxide diffuses into mesophyll cells.

**13. Differentiate between dark and light reactions.**

**(LHR 2012)**

**Ans:**

LIGHT REACTIONS	DARK REACTIONS
<ul style="list-style-type: none"><li>• It is the first phase of photosynthesis.</li><li>• Light energy is captured and is used to make high-energy molecules (ATP and NADPH)</li><li>• It takes place on the thylakoid membranes of chloroplasts.</li><li>• These reactions require light.</li></ul>	<ul style="list-style-type: none"><li>• It is the second phase of photosynthesis.</li><li>• Carbon dioxide is reduced to make glucose and energy from high-energy molecules (ATP and NADPH) is utilized.</li><li>• It takes place in the stroma of the chloroplasts.</li><li>• These reactions do not use light directly.</li></ul>

**14. What is  $\text{NAD}^+$ ?**

**Ans:** Nicotinamide adenine dinucleotide ( $\text{NAD}^+$ ) is a coenzyme that takes electrons and hydrogen ions and is thus reduced to NADH. One form of this coenzyme also carries phosphate with it, so called  $\text{NADP}^+$

**15. Show summary of photosynthesis in the form of a diagram.**

**Ans:**

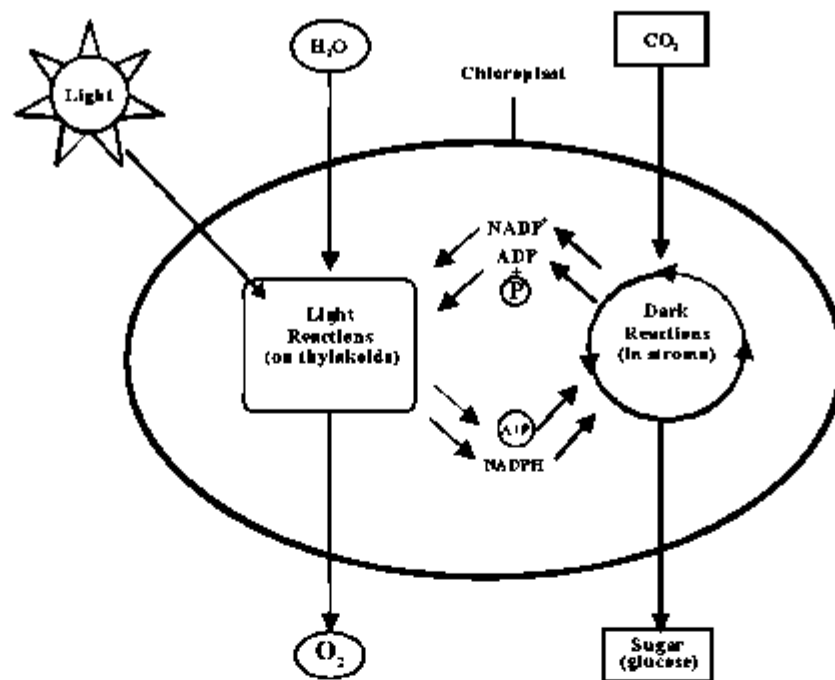


Figure: Summary of Photosynthesis

**16. What is meant by photolysis?**

(LHR 2016)

**Ans:** "Break down of water molecule during light reactions is called photolysis".

- It takes place with the help of light energy and oxygen released.

**17. Who discovered Dark reactions?**

Text Book Page # 122

**Ans:** The details of Dark reactions were discovered by Malvin Calvin and his colleagues at the university of California. Calvin was awarded Nobel Prize in 1961 for his work on the details of photosynthesis.

**18. Draw the Z-scheme for light reactions.**

**Ans:**

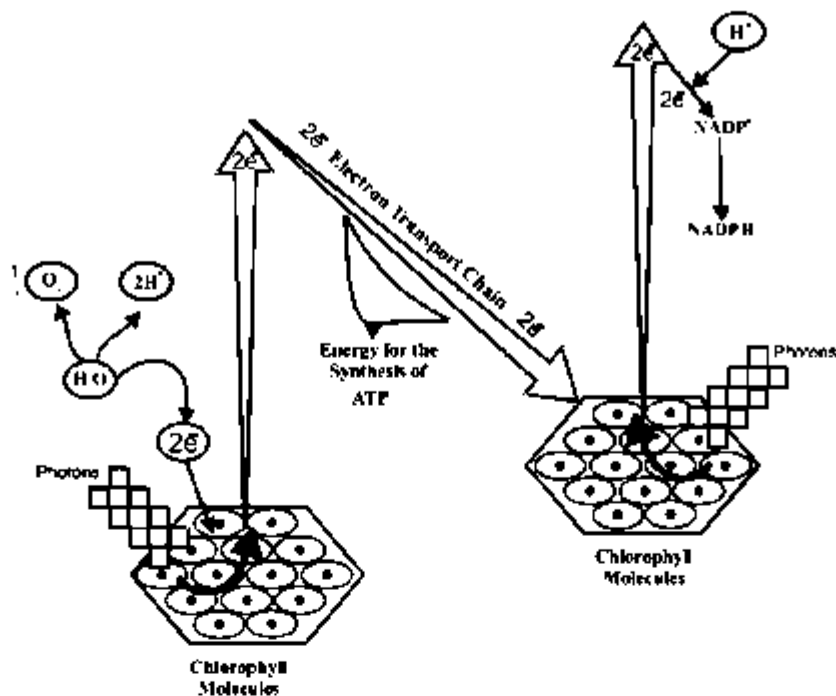


Figure: Light Reactions of Photosynthesis

**19. What is the function of chlorophyll in photosynthesis?**

**Ans:** Sunlight energy is absorbed by chlorophyll. It is then converted into chemical energy, which drives the photosynthetic process. Only about one percent of the light falling on the leaf surfaces is absorbed, the rest is reflected or transmitted. Chlorophylls mainly absorb red and blue lights.

**20. Define photosystems.**

Text Book Page # 123

(SWL 2015)

**Ans:** "Photosynthetic pigments are organized in the form of clusters called photosystems, in thylakoid membranes of chloroplasts."

**Main Pigment:**

Chlorophyll-a is the main photosynthetic pigment

**21. What is meant by pigments?**

(RWP 2015)

**Ans: Pigments:**

"Pigments are the substances that absorb visible light. Different pigments absorb light of different wavelengths (colours)."

**22. Define limiting factor.**

Text Book Page # 124

(MTN 2015, GRW 2015, DGK 2014, RWP 2014, 2015)

**Ans: Definition:**

"Any environmental factor the absence or deficiency of which can decrease the rate of a metabolic reaction, is called limiting factor for that reaction".

**Important Limiting Factors:**

Many factors act as limiting factors for photosynthesis like:

- Light intensity



- Temperature
- Carbon dioxide

**23. What is effect of light intensity on photosynthesis?**

**Ans:** The rate of photosynthesis varies with light intensity. It decreases as the light intensity decreases and increases as the light intensity increases. However, at much higher light intensity, the rate of photosynthesis becomes constant.

**24. How the temperature affects rate of photosynthesis? (LHR 2012)**

**Ans:** The rate of photosynthesis decreases with decrease in temperature. It increases as temperature is increased over a limited range.

**25. What is the effect of carbon dioxide concentration on photosynthesis? (GRW 2014, RWP 2015)**

**Ans:** As carbon dioxide concentration rises, the rate of photosynthesis goes on increasing until limited by other factors. Increase in carbon dioxide concentration beyond a certain level causes the closure of stomata and it decreases the rate of photosynthesis.

**26. There are more chloroplasts in the palisade mesophyll than spongy mesophyll, why?**

**Ans:** There are more chloroplasts in the palisade mesophyll than spongy mesophyll because the palisade cells are on the upper surface and receive more light, so they contain more chloroplasts to be able to absorb more light.

**27. Define cellular respiration. Text Book Page # 130 (LHR 2014, 2016, BWP 2014, RWP 2014, FSD 2015)**

**Ans:** "It is a process in which C-H bonds in food are broken down by oxidation reduction reactions and energy is released in the form of ATP."

It is of two types:

- Aerobic respiration
- Anaerobic respiration

**28. Define aerobic respiration. Write its equation. (GRW 2012, 2013, 2014, SWL 2014, MTN 2015)**

**Ans:** "The cellular respiration occurring in the presence of oxygen is called aerobic respiration"  
The overall reaction is as follows:



**29. What is anaerobic respiration? Text Book Page # 131 (SWL 2015)**

**Ans:** "The respiration that occurs in the absence of oxygen is called anaerobic respiration".  
In the absence of oxygen, glucose is incompletely oxidized with less amount of energy released. In anaerobic respiration, the first phase is exactly similar to that of aerobic respiration. A molecule of glucose is broken down into two molecules of pyruvic acid. But

in the second phase, pyruvic acid is not completely oxidized. It is transformed into ethyl alcohol or lactic acid. In this way many of the C-H bonds are left unbroken in the products.

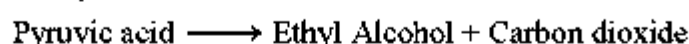
**30. What is alcoholic fermentation?**

**(DGK 2015)**

**Ans: Alcoholic fermentation:**

In this type of anaerobic respiration, pyruvic acid is further broken down into alcohol ( $C_2H_5OH$ ) and  $CO_2$ .

It occurs in bacteria, yeast etc.



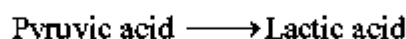
**31. What is lactic acid fermentation?**

**(LHR 2016)**

**Ans: Lactic Acid Fermentation:**

It occurs in skeletal muscles of humans and other animals during extreme physical activities.

This also happens in the bacteria present in milk. In this type of anaerobic respiration, each pyruvic acid molecule is converted into lactic acid ( $C_2H_5O_3$ ).



**32. What is difference between aerobic and anaerobic respiration?**

**(LHR 2012, 2015, 2016, BWP 2015, FSD 2014, SGD 2015)**

**Ans:**

<b>AEROBIC RESPIRATION</b>	<b>ANAEROBIC RESPIRATION</b>
<ul style="list-style-type: none"><li>• "The cellular respiration occurring in the presence of oxygen is called aerobic respiration"</li><li>• In the presence of oxygen, complete oxidation of glucose occurs with maximum release of energy.</li><li>• 36 ATP's are produced as a result of aerobic respiration.</li></ul>	<ul style="list-style-type: none"><li>• "The cellular respiration occurring in the absence of oxygen is called anaerobic respiration"</li><li>• In the absence of oxygen, glucose is incompletely oxidized with less amount of energy released.</li><li>• 2 ATP's are produced as a result of anaerobic respiration.</li></ul>

**33. How fermentation is important to living organisms?**

**Ans: Evolution of Life:**

When life evolved on Earth, the early land or water habitats did not have any supply of free oxygen ( $O_2$ ). In these anaerobic conditions, early organisms respired anaerobically and got energy for their life activities.

**Industrial usage:**

Scientists have used the fermenting abilities of fungi and bacteria for the benefit of mankind.

**Examples:**

- The fermenting powers of bacteria are used for making cheese and yogurt.
- Fermentation in yeasts is used in brewing and baking industries.
- Soy sauce is made by the fermentation of a fungus *Aspergillus*

**34. Name the steps involved in respiration.**

**Text Book Page # 132**

**Ans:** Aerobic respirations involves following steps.

- (i) Glycolysis
- (ii) Kreb's cycle
- (iii) Electron transport chain.

Anaerobic respiration involves only glycolysis.

**35. Differentiate between photosynthesis and respiration.**

**Ans:**

PHOTOSYNTHESIS	RESPIRATION
<ul style="list-style-type: none"> <li>It is an Anabolic reaction.</li> <li>Light energy is stored in the form of chemical energy.</li> <li>It occurs in plants, algae and some photosynthetic bacteria.</li> <li>Energy is used to produced glucose.</li> </ul>	<ul style="list-style-type: none"> <li>It is a Catabolic reaction.</li> <li>C-H bonds in food are broken down by oxidation reduction reactions.</li> <li>It occurs in all organisms.</li> <li>Energy is released in the form of ATP.</li> </ul>

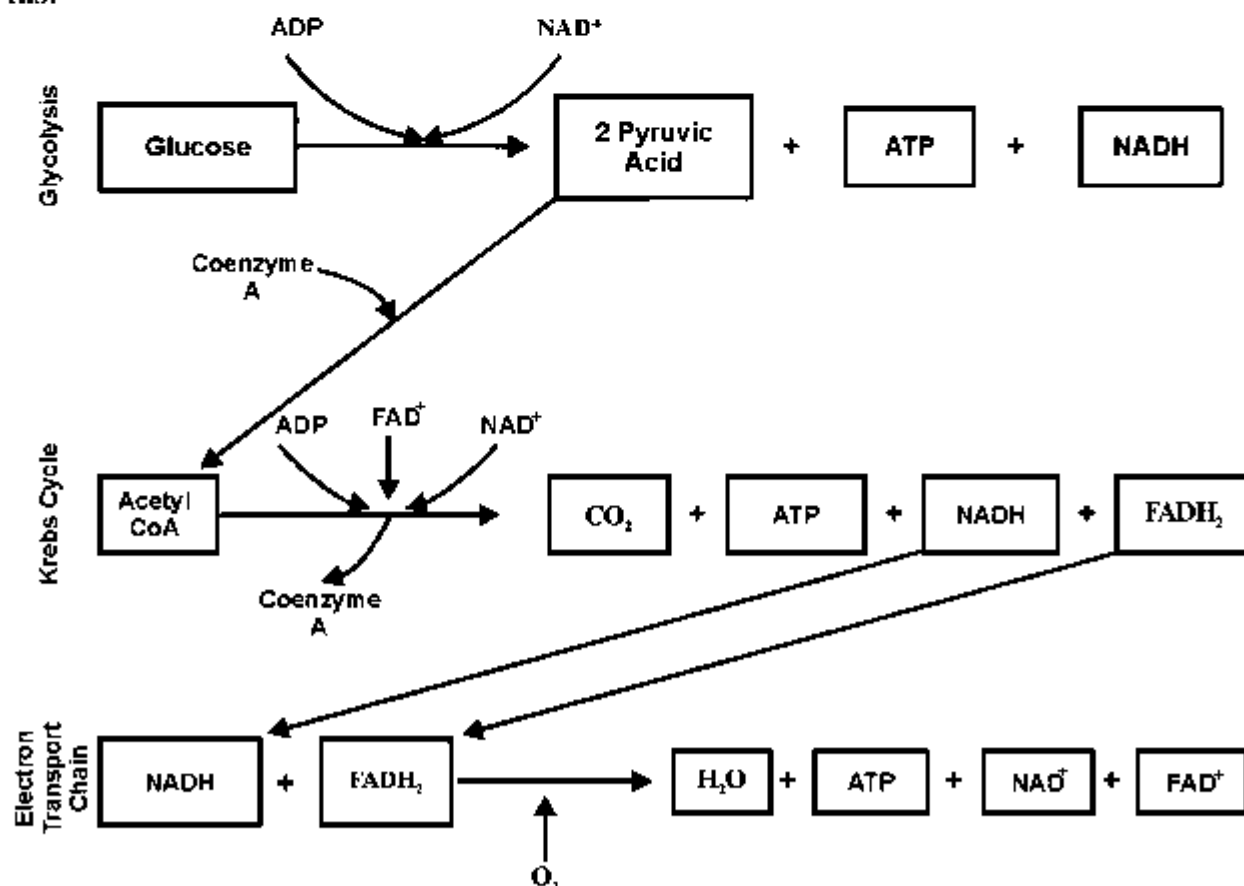
**36. What do you know about FAD<sup>+</sup>?**

(GRW 2015)

**Ans:** Flavin adenine dinucleotide (FAD) is also a coenzyme like NAD<sup>+</sup>. It gets 2 hydrogen and reduces to FADH<sub>2</sub>.

**37. Express the complete mechanism of respiration in form of equation.**

**Ans:**



**38. Why it is incorrect to say that energy releasing step of respiration is electron transport chain?**

**Ans:** Energy is released in glycolysis and kreb's cycle in the form of NADH and FADH<sub>2</sub>. Electron transport chain transforms the energy present in these compounds to ATP.

**39. How many energy molecules are produced in aerobic and anaerobic respiration.**

**Ans:** 36 ATP molecules are produced as a result of aerobic respiration while 2 ATP molecules are produced as a result of anaerobic respiration.

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## Unit 7: Bioenergetics

### Multiple Choice Questions

1. Food contains energy in its bonds in the form of: Text Book Page#117 (LHR 2013)  
(a) Kinetic energy (b) Potential energy  
(c) Mechanical energy (d) All of these
2. The loss of electrons is called: Text Book Page#118 (GRW 2015, DGK 2014)  
(a) Oxidation (b) Reduction  
(c) Redox (d) Both a & b
3. Gain of electrons is called:  
(a) Oxidation (b) Reduction  
(c) Redox (d) Both a & b
4. ATP was discovered by: Text Book Page#118 (GRW 2012, BWP 2015)  
(a) Fritz Lipmann (b) Karl Lohmann  
(c) Malvin Calvin (d) Sir Hans Krebs
5. ATP was discovered in: (GRW 2014, LHR 2012)  
(a) 1923 (b) 1925  
(c) 1927 (d) 1929
6. ATP is an example of: (LHR 2016)  
(a) Amino acid (b) Fatty acid  
(c) Nucleic acid (d) Nucleotide
7. The ATP was proposed to be the main energy transfer molecule in the cell by:  
(a) Fritz Lipmann (b) Karl Lohmann  
(c) Malvin Calvin (d) Sir Hans Krebs
8. Each ATP molecule has subunits: (GRW, 2012, LHR 2012, SGD 2014)  
(a) Two (b) Three  
(c) Four (d) Five
9. Number of phosphate groups in ATP molecule: (SGD 2015)  
(a) One (b) Two  
(c) Three (d) Four
10. From which bond of A.T.P. molecule energy is taken? (GRW 2012)  
(a) C-N bond (b) C-O bond  
(c) C-H bond (d) P-P bond
11. The covalent bond connected to two phosphate is: (LHR 2014)  
(a) Ratio (b) Proportion  
(c) Colon (d) Tilde
12. How much energy is released by breaking of one phosphate bond of ATP?  
Text Book Page#120 (LHR 2012, MTN 2014, FSD 2014)  
(a) 7100 calories (b) 7200 calories  
(c) 7300 calories (d) 7400 calories
13. When one inorganic phosphate is detached from ATP, it is converted into:  
(a) ADP (b) AMP  
(c) Both a & b (d) None of these

- 14. Photosynthesis is:**  
 (a) Anabolic process (b) Catabolic process  
 (c) Both (a) and (b) (d) Physical process
- 15. In which process oxygen is released as a by-product?**  
 (DGK 2014, GRW 2015, BWP2014)  
 (a) Photosynthesis (b) Respiration  
 (c) Fermentation (d) Reproduction
- 16. Light reactions take place on:**  
 Text Book Page#121 (LHR 2012, 2013)  
 (a) Thylakoid membranes (b) Stroma of chloroplasts  
 (c) Mitochondria (d) All of these
- 17. Dark reactions take place in:**  
 (a) Thylakoid membranes (b) Stroma of chloroplasts  
 (c) Mitochondria (d) All of these
- 18. NADPH is formed during:**  
 (a) Light reactions (b) Dark reactions  
 (c) Both (a) & (b) (d) None of these
- 19. The break down of water molecule during light reactions is called:**  
 (a) Glycolysis (b) Krebs's Cycle  
 (c) ETC (d) Photolysis
- 20. The details of dark reactions were discovered by:**  
 Text Book Page#122  
 (a) Karl Lohmann (b) Fritz Lipmann  
 (c) Malvim Calvin (d) All of these
- 21. When was Calvin awarded Nobel Prize?**  
 (a) 1960 (b) 1961  
 (c) 1962 (d) 1963
- 22. Photosynthetic pigments are arranged in the form of clusters called:**  
 Text Book Page#123  
 (a) Carotenoids (b) Chlorophyll-a  
 (c) Chlorophyll-b (d) Photosystems
- 23. Main photosynthetic pigment:**  
 (LHR 2016)  
 (a) Carotenoids (b) Chlorophyll-a  
 (c) Chlorophyll-b (d) All of these
- 24. Sun light is absorbed by:**  
 (RWP 2015)  
 (a) Flower (b) Stem  
 (c) Chlorophyll (d) Roots
- 25. Chlorophyll pigment absorbs maximum light in wavelengths of:**  
 (GRW 2013, SWL 2014, MTN 2015)  
 (a) Green and blue (b) Green and red  
 (c) Green (d) Red and blue
- 26. Which one factor does not affect the rate of photosynthesis?**  
 Text Book Page#124  
 (a) Light (b) Temperature  
 (c) Humidity (d) CO<sub>2</sub>
- 27. From which bond of food energy is taken?**  
 Text Book Page#130  
 (a) P-P bonds (b) C-H bonds  
 (c) C-N bonds (d) C-O bonds

28. The greatest fuel of energy of cellular respiration is: (RWP 2014)  
 (a) Glucose (b) Proteins  
 (c) Amino acid (d) Lipids
29. In cellular respiration, food is oxidized to:  
 (a) CO<sub>2</sub> (b) H<sub>2</sub>O  
 (c) Both a & b (d) CO
30. The most common fuel used by cell to get energy from cellular respiration is:  
 (a) Glucose (b) Oxygen  
 (c) Carbon dioxide (d) Food
31. Through which process organism gets energy? (SGD 2015)  
 (a) Photosynthesis (b) Respiration  
 (c) Transpiration (d) Evaporation
32. Alcoholic fermentation occurs in: Text Book Page#131  
 (a) Bacteria (b) Yeast  
 (c) Both (a) and (b) (d) Humans
33. Whose fermenting powers are used for making cheese and yogurt? (SGD 2014)  
 (a) Bacteria (b) virus  
 (c) Fungi (d) Algae
34. In which phase of respiration glucose molecule is broken in to two molecules of pyruvic Acid?  
 (a) Glycolysis (b) Krebs cycle  
 (c) Electron transport chain (d) None of these
35. Soy sauce is made through the fermentation by a fungus:  
 (a) *Rhizopus* (b) *Penicillium*  
 (c) *Aspergillus* (d) All of these
36. How many stages are present in aerobic respiration? Text Book Page#132  
 (a) 1 (b) 2  
 (c) 3 (d) 4
37. Process of glycolysis is found in: (GRW 2014, LHR 2015)  
 (a) Ribosomes (b) Cytoplasm  
 (c) Golgi complex (d) Vacuole
38. In electron transport chain each NADH produces: Text Book Page#133  
 (a) 2 ATP (b) 3 ATP  
 (c) 4 ATP (d) 5 ATP
39. In which step of respiration CO<sub>2</sub> is produced? (GRW 2013)  
 (a) Glycolysis (b) Krebs cycle  
 (c) Electron transport chain (d) All of these
40. How many molecules of CO<sub>2</sub> are produced when kreb's cycle operates once? (LHR 2015, MTN 2015)  
 (a) 6 (b) 3  
 (c) 2 (d) 1
41. How many ATP molecules are generated in aerobic respiration? (GRW 2009, LHR 2014)  
 (a) 2 (b) 24  
 (c) 34 (d) 36



42. In cell, aerobic respiration sites are:

(SGD 2015)

- (a) Golgi bodies (b) Mitochondria  
(c) Ribosomes (d) Chloroplast

43. How many ATP molecules are generated in anaerobic respiration?

- (a) 2 (b) 24  
(c) 34 (d) 36

44. Krebs cycle and electron transport chain occur in:

Text Book Page#136

- (a) Cytoplasm (b) Nucleus  
(c) Mitochondria (d) Ribosomes

**ANSWERS KEY**

1	b	11	d	21	b	31	b	41	d
2	a	12	c	22	d	32	c	42	b
3	b	13	a	23	b	33	a	43	a
4	b	14	a	24	c	34	a	44	c
5	d	15	a	25	d	35	c		
6	d	16	a	26	c	36	c		
7	a	17	b	27	b	37	b		
8	b	18	a	28	a	38	b		
9	c	19	d	29	c	39	b		
10	d	20	c	30	a	40	c		

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## Unit 7: Bioenergetics

### Long Questions

**Q.1 Define Bio-energetics and Discuss energy transformations in living organisms.**

Text Book Page # 117

**Ans: Bio-energetics:**

"It is the study of energy relationships and energy transformations in living organisms."

#### ENERGY TRANSFORMATIONS

Organisms obtain energy by metabolizing the food they eat or prepare. Food contains potential energy in its bonds. When these bonds are broken down, a large amount of kinetic energy is usually released. Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out life activities.

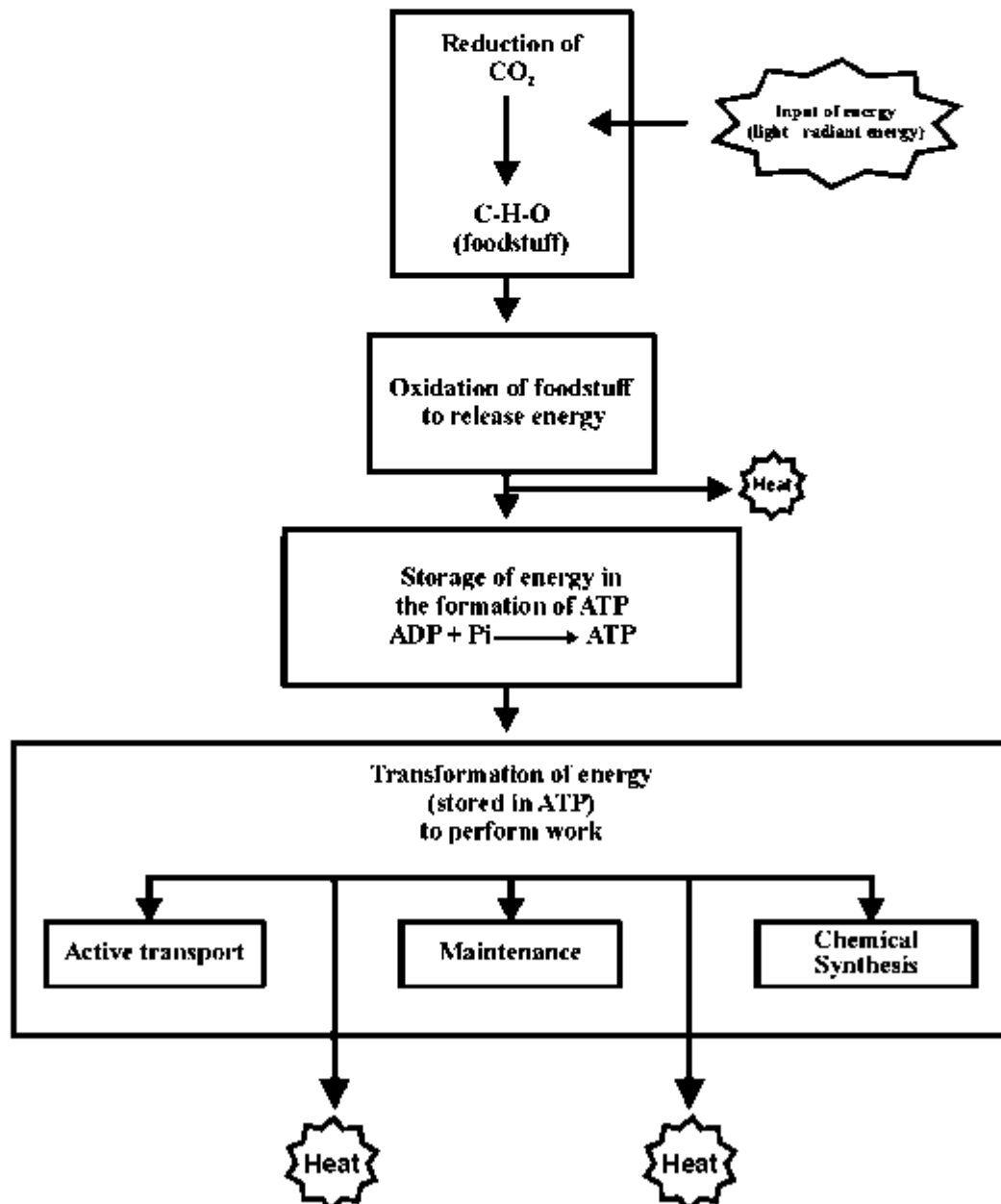


Figure: Energy Transformations in Living Organisms

**Q.2 Write a note on Oxidation –Reduction Reactions.**

**Text Book Page # 118 (MTN 2014, BWP 2014)**

**Ans:**

### **OXIDATION-REDUCTION REACTIONS**

Various life processes in organisms involve constant flow of energy. This energy flow comprises the acquisition, transformation of energy and use of energy for various life processes like:

- Growth
- Movement
- Reproduction

For all life processes, oxidation-reductions reactions (redox reactions) are the direct source of energy.

**Redox Reactions:**

Redox reactions involve exchange of electrons between atoms.

**Oxidation:**

The loss of electrons is called oxidation.

**Reduction:**

The gain of electrons is called reduction.

**Electrons as Source of Energy:**

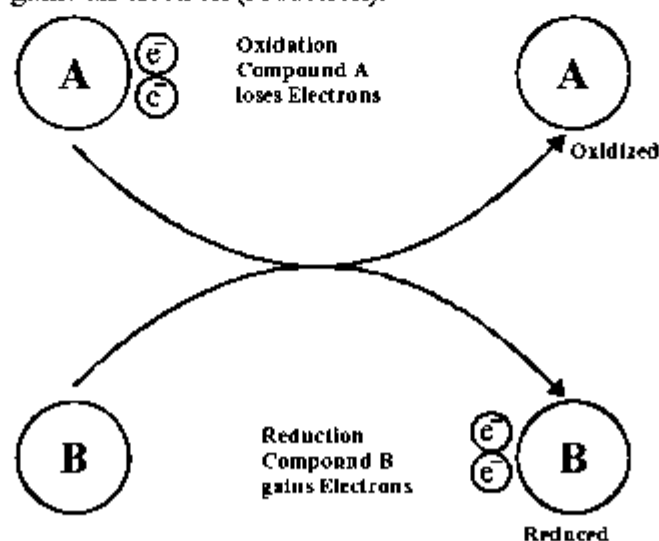
Electrons can be an energy source. It depends upon their location and arrangement in atoms.

**Examples:**

- When electrons are present in oxygen, they make stable association with oxygen atom and are not good energy source.
- If electrons are dragged away from oxygen and attached to some other atom e.g. carbon or hydrogen, they make unstable association. They try to move back to oxygen and when this happens, energy is released.

**Redox Reactions in Living Organisms:**

In living organisms, redox reactions involve the loss and gain of hydrogen atoms. A hydrogen atom contains one proton and one electron. It means that when a molecule loses a hydrogen atom, it actually loses an electron (oxidation). Similarly, when a molecule gains a hydrogen atom, it actually gains an electron (reduction).



**Figure: Redox Reactions**

Q.3 Write a note on ATP.

Text Book Page # 119

(SGD 2015)

Ans:

**ATP: THE CELL'S ENERGY CURRENCY****Introduction:**

The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP).

**Discovery:**

ATP was discovered in 1929 by Karl Lohmann.

**Work of Fritz Lipmann:**

In 1941, Fritz Lipmann proposed ATP to be the main energy-transfer molecule in the cell. He was awarded Nobel Prize.

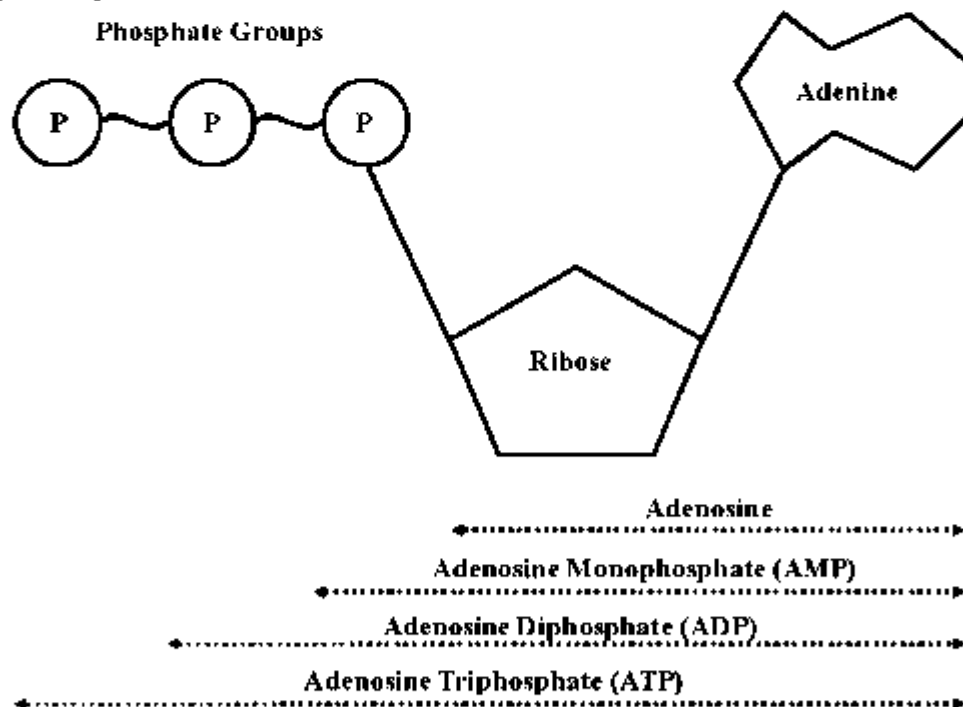
**Significance:**

ATP is the main energy source for majority of the cellular functions like:

- Synthesis of macromolecules (DNA, RNA, proteins)
- Movement
- Transmission of nerve impulses
- Active transport
- Exocytosis
- Endocytosis

**Evolution of ATP:**

ATP plays a central role as energy currency in all organisms, it must have appeared in the early history of life.

**Molecular Structure of ATP:**

The ability of ATP to store and release energy is due to its molecular structure. Each ATP molecule has three subunits:

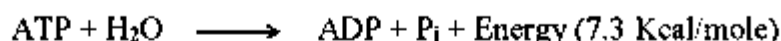
- (i) Adenine (a double-ringed nitrogenous base)
- (ii) Ribose (a five-carbon sugar)
- (iii) Three phosphate groups in a linear chain

Tilde bond:

The covalent bond connecting two phosphates is indicated by 'tilde' (~) and is a high energy bond. The energy in this bond is released as it breaks and inorganic phosphate (Pi) gets separated from ATP.

**Breakdown of ATP:**

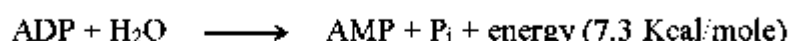
The breaking of one phosphate bond releases about 7.3 Kcal (7,300 calories) per mole of ATP as follows:



In common energy reactions, only the outermost of the two high-energy bonds breaks. When this happens, ATP becomes ADP (adenosine diphosphate) and one Pi is released.

**Breakdown of ADP:**

In some cases, ADP is further broken down to AMP (adenosine monophosphate) and Pi as follows:



**Synthesis of ATP:**

Cells constantly recycle ADP by recombining it with Pi to form ATP. The synthesis of ATP from ADP and Pi requires the expenditure of 7.3 kcal of energy per mole. This energy is obtained from the oxidation of foodstuff.

**Conclusion:**

ATP is generated by energy-releasing processes and is broken down by energy-consuming processes. In this way, ATP transfers energy between metabolic reactions.

**Energy Storage:**

When cells use energy to build ATP from ADP, or ADP from AMP, they are storing energy as we put money in a bank.

**Q.4 What is photosynthesis? Explain intake of water and carbon dioxide.**

Text Book Page # 120+121 (GWR 2015)

**Ans:**

**PHOTOSYNTHESIS**

**Definition:**

The process of synthesis of glucose from carbon dioxide and water in the presence of sunlight and chlorophyll, with oxygen as a by-product is called as photosynthesis.

- Photosynthesis is an important anabolic (building) process. It comprises many coordinated biochemical reactions.

**Importance:**

- It is an important component of bioenergetics in living systems.
- It is the most important biochemical pathway and nearly all life depends on it.

**Photosynthetic Organisms:**

It comprises many co-ordinated bio-chemical reactions that occur in:

- Plants
- Some protists (algae)
- Some bacteria

**General Equation:**



### INTAKE OF WATER & CARBONDIOXIDE

#### **Raw materials**

Water and carbon dioxide are the raw materials for photosynthesis. Plants have mechanisms for the intake and transport of these raw materials.

#### **Intake of Water:**

Water, present in soil, is absorbed by root and root hairs through osmosis. This water is eventually transported to the leaves through xylem vessels.

#### **Intake of Carbon dioxide:**

The air that enters leaf through tiny pores (stomata) reaches into the air spaces present around mesophyll cells. This air carries  $\text{CO}_2$ , which gets absorbed in the thin layer of water surrounding mesophyll cells. From here, the carbon dioxide diffuses into mesophyll cells.

#### **Role of Stomata:**

Stomata cover only 1-2% of the leaf surface but they allow much air to pass through them.

**Q.5** Describe mechanism of photosynthesis in detail. Text Book Page # 121 (DGK 2014)

**Ans:**

### MECHANISM OF PHOTOSYNTHESIS

Photosynthesis occurs in two phases:

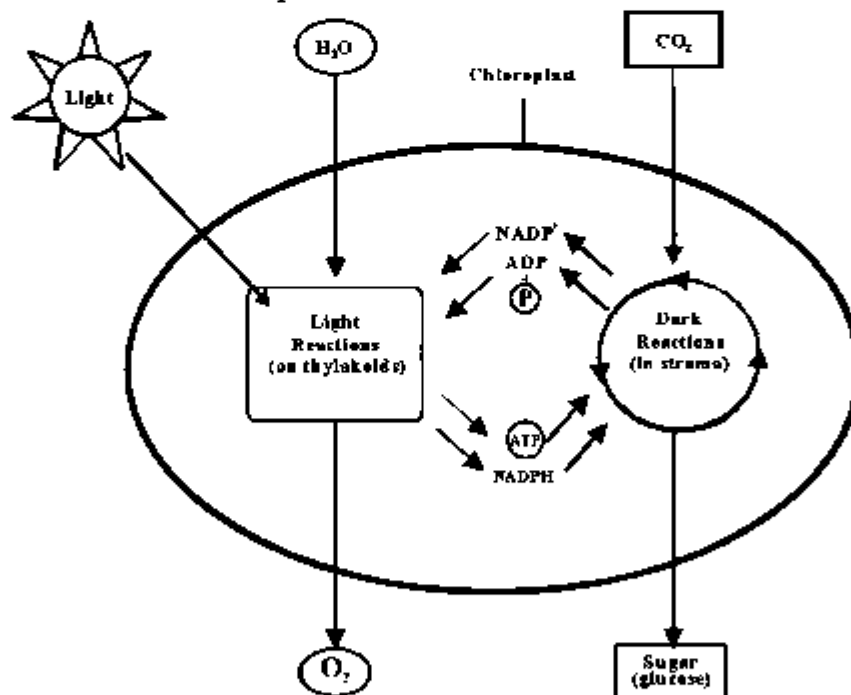


Figure: Summary of Photosynthesis

#### **Light Reactions:**

During first phase, light energy is captured and is used to make high energy molecules (ATP and NADPH). These reactions, which are known as light reactions, take place on the thylakoid membranes of chloroplasts.

#### **Dark Reactions:**

During second phase, carbon dioxide is reduced to make glucose. In this phase, the energy from high energy molecules (ATP and NADPH) is utilized. Since these reactions do not use light directly, they are known as dark reactions. The dark reactions take place in the stroma of the chloroplasts.

**Q.6 Write a detailed note on light and dark reactions of photosynthesis.**

**Ans:**

**1. Light reactions:** (LHR 2013, 2014, 2016, GWR 2015, SWL 2015)

During first phase, light energy is captured and is used to make high energy molecules (ATP and NADPH).

These reactions, which are known as light reactions, take place on the thylakoid membranes of chloroplasts.

The summary of events of light reactions is as follows.

**(i) Emission of Electrons:**

When chlorophyll molecules absorb light, their energy level increases and their electrons are emitted.

**(ii) Synthesis of ATP:**

Electrons are passed to electron transport chain to produce ATP.

**(iii) Photolysis:**

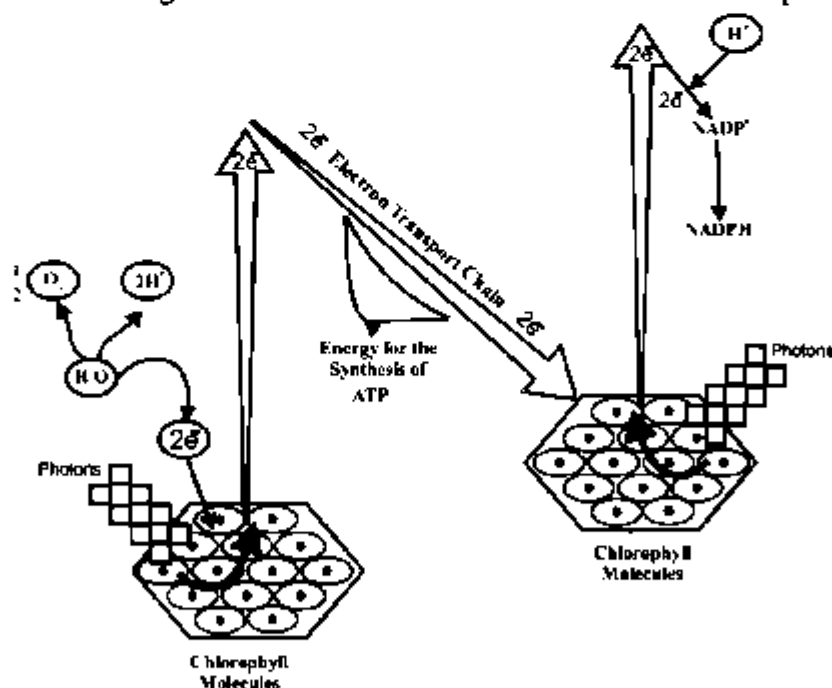
Light breaks water molecule (photolysis) and oxygen is released. Hydrogen atoms of water give electrons to chlorophyll and become ions.

**(iv) Reduction of NADP:**

The electrons of chlorophyll, after the production of ATP, and hydrogen ions of water are used for the reduction of  $\text{NADP}^+$  into NADPH.

**Z-scheme:**

The whole series of light reactions is called Z-scheme due to its Z-shaped flowchart.



**Figure: Light Reactions of Photosynthesis**

**2. Dark reactions:**

(LHR 2013, GWR 2014, SWL 2014, DGK 2015, BWP 2015, FSD 2014, SGD 2015)

During second phase, carbon dioxide is reduced to make glucose. In this phase, the energy from high energy molecules (ATP and NADPH) is utilized.

Since these reactions do not use light directly, these are known as dark reactions.

The dark reactions take place in the stroma of the chloroplasts.

**Discovery:**



The details of Dark reactions were discovered by Malvin Calvin and his colleagues at the university of California. Calvin was awarded Nobel Prize in 1961 for his work on the details of photosynthesis.

The summary of events of dark reactions also known as Calvin cycle is as follows.

**a. 6-C Compounds:**

CO<sub>2</sub> molecules are combined with 5-carbon compounds to form temporary 6-carbon compounds, each of which splits into two 3-carbon compounds.

**b. 3-C Carbohydrates:**

The 3-carbon compounds are reduced to 3-carbon carbohydrates by using ATP and hydrogen from NADPH. The 3-carbon carbohydrates are used to manufacture glucose.

**c. 5-C Compounds:**

The 3-carbon carbohydrates are also used to generate the original 5-carbon compounds. This step also utilizes ATP.

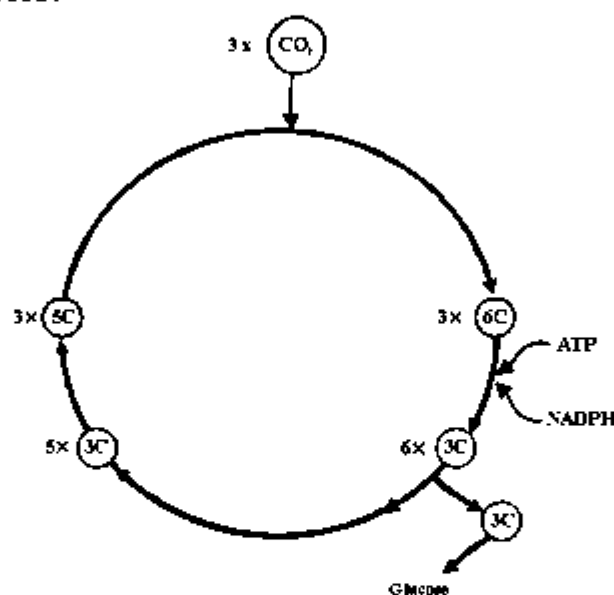


Figure: Dark Reactions of Photosynthesis  
(The Calvin Cycle)

**Important:**

Nicotinamide adenine dinucleotide (NAD<sup>+</sup>) is a coenzyme that takes electrons and hydrogen ions and is thus reduced to NADH. One form of this coenzyme also carries phosphate with it, so called NADP<sup>+</sup>

**Q.7** Discuss role of chlorophyll and light in photosynthesis. Text Book Page # 122+123 (SGD 2014)

**Ans:** ROLE OF CHLOROPHYLL AND LIGHT

**Absorption of Sunlight Energy:**

- Sunlight energy is absorbed by chlorophyll. It is then converted into chemical energy, which drives the photosynthetic process.
- Only about 1% of the light falling on the leaf surface is absorbed, the rest is transmitted or reflected.

- The light rays of different wavelengths are not only differently absorbed by photosynthetic pigments, but are also differently effective in photosynthesis. The blue and red lights carry out more photosynthesis.

**Pigments:**

Pigments are the substances that absorb visible light. Different pigments absorb light of different wavelengths (colours).

**Photosystems:**

Photosynthetic pigments are organized in the form of clusters called photosystems, in thylakoid membranes of chloroplasts.

**Main Pigment:**

Chlorophyll-a is the main photosynthetic pigment.

**Accessory Pigments:**

Chlorophyll-b and carotenoids are the accessory pigments.

**Role of Chlorophyll:**

Chlorophylls mainly absorb red and blue lights. Some wavelengths not absorbed by Chlorophyll 'a' are very effectively absorbed by accessory pigments and vice versa.

**Q.8 Define limiting factor. Explain some of the limiting factors in photosynthesis.**

**Text Book Page # 124 (LHR 2015, MTN 2015)**

**Ans:**

**LIMITING FACTORS**

**Definition:**

Any environmental factor the absence or deficiency of which can decrease the rate of a metabolic reaction, is called limiting factor for that reaction

**Important Limiting Factors:**

Many factors act as limiting factors for photosynthesis like:

- Light intensity
- Temperature
- Concentration of carbon dioxide
- Availability of water

**Effect of Light Intensity:**

The rate of photosynthesis varies with light intensity. It decreases as the light intensity decreases and increases as the light intensity increases. However, at much higher light intensity, the rate of photosynthesis becomes constant.

**Effect of Temperature:**

The rate of photosynthesis decreases with decrease in temperature. It increases as temperature is increased over a limited range. But if light intensity is low, increasing the temperature has little influence on the rate of photosynthesis.

**Effect of Carbon dioxide Concentration:**

As carbon dioxide concentration rises, the rate of photosynthesis goes on increasing until limited by other factors. Increase in carbon dioxide concentration beyond a certain level causes the closure of stomata, and it decreases the rate of photosynthesis.

**Q.9 Define respiration. Also discuss aerobic and anaerobic respiration.**

**Text Book Page # 130**

**Ans:**

### **RESPIRATION**

**Definition:**

The cellular energy-yielding process in which food is oxidized by breaking C-H bonds through oxidation-reduction reactions to produce carbon dioxide and water, is called cellular respiration.

**Oxidation-Reduction Reaction:**

In Cellular respiration food is oxidized to CO<sub>2</sub> while O<sub>2</sub> is reduced to H<sub>2</sub>O.

### **TYPES OF RESPIRATION**

There are two main types of respiration:

- (i) Aerobic respiration
- (ii) Anaerobic respiration

### **AEROBIC RESPIRATION**

**Definition:**

The cellular respiration occurring in the presence of oxygen is called aerobic respiration.

In the presence of oxygen, complete oxidation of glucose occurs with maximum release of energy. Mechanism of aerobic respiration is as follows.

- **First Phase:**

In the first phase of aerobic respiration, a molecule of glucose (6-C) is broken down into two molecules of pyruvic acid (3-C).

- **Second Phase:**

In the second phase, molecules of pyruvic acid are completely oxidized (all C-H bonds are broken) to CO<sub>2</sub> and water, and all energy is released.

**Chemical Equation:**

The overall reaction is as follows:



### **ANAEROBIC RESPIRATION (FERMENTATION)**

**Definition:**

The cellular respiration occurring in the absence of oxygen is called anaerobic respiration.

- In the absence of oxygen, glucose is incompletely oxidized with less amount of energy released. The mechanism of anaerobic respiration is as follows.

- **First Phase:**

The first phase is exactly similar to that of aerobic respiration. A molecule of glucose is broken down into two molecules of pyruvic acid.

- **Second Phase:**

In the second phase, pyruvic acid is not completely oxidized due to the absence of oxygen. It is transformed into ethyl alcohol or lactic acid. In this way, many of the C-H bonds are left unbroken in the products.

### **TYPES OF FERMENTATION**

Anaerobic respiration or fermentation is further classified into:

- (i) **Alcoholic Fermentation:**

It occurs in:

- Bacteria
- Yeast

In this type of anaerobic respiration, pyruvic acid is further broken down into alcohol ( $C_2H_5OH$ ) and  $CO_2$ .



(ii) **Lactic Acid Fermentation:**

It occurs in:

- Skeletal muscles of humans and other animals during extreme physical activities
- Bacteria present in milk

In this type of anaerobic respiration, each pyruvic acid molecule is converted into lactic acid ( $C_2H_6O_3$ ).



**Q.10 Discuss the importance of fermentation in detail.**

Text Book Page # 131 (GWR 2014, DGK 2015)

Ans:

**IMPORTANCE OF FERMENTATION**

**Evolution of Life:**

When life evolved on Earth, the early land or water habitats did not have any supply of free oxygen ( $O_2$ ). In these anaerobic conditions, early organisms respired anaerobically and got energy for their life activities.

**Anaerobes:**

Even today, when free oxygen is available, some organisms including some bacteria and some fungi get energy from anaerobic respiration and are called anaerobes.

**Hard Exercise:**

Humans can also provide energy to their skeletal muscle cells through anaerobic respiration. This happens when skeletal muscles have to work hard, (during exercise etc.) but oxygen supply cannot be increased to fulfill the demand.

**Industrial Usage:**

Scientists have used the fermenting abilities of fungi and bacteria for the benefit of mankind.

**Examples:**

- The fermenting powers of bacteria are used for making cheese and yogurt.
- Fermentation in yeasts is used in brewing and baking industries.
- Soy sauce is made by the fermentation of a fungus *Aspergillus*.

**Q.11 Describe Mechanism of Respiration.**

Text Book Page # 132 (LHR 2014, 2016, SWL 2014, 2015)

Ans:

**MECHANISM OF RESPIRATION**

The process of respiration involves a complex series of reactions.

Aerobic respiration is a continuous process but for our convenience, we divide it into three main stages:

(i) **Glycolysis:**

- Glycolysis occurs in the cytoplasm and oxygen is not involved in this stage. That is why, it occurs in both types of respiration i.e. aerobic and anaerobic.

- In glycolysis, glucose (6-C) molecule is broken into two molecules of Pyruvic acid (3-C).

(ii) **Krebs Cycle:**

- Krebs Cycle is named after Sir Hans Krebs who discovered this series of reactions.
- In krebs cycle, pyruvic acids molecules are completely oxidized, along with the formation of ATP, NADH and  $\text{FADH}_2$ .
- Before entering into Krebs Cycle, pyruvic acid is changed into 2-C compound called acetyl Co-A.

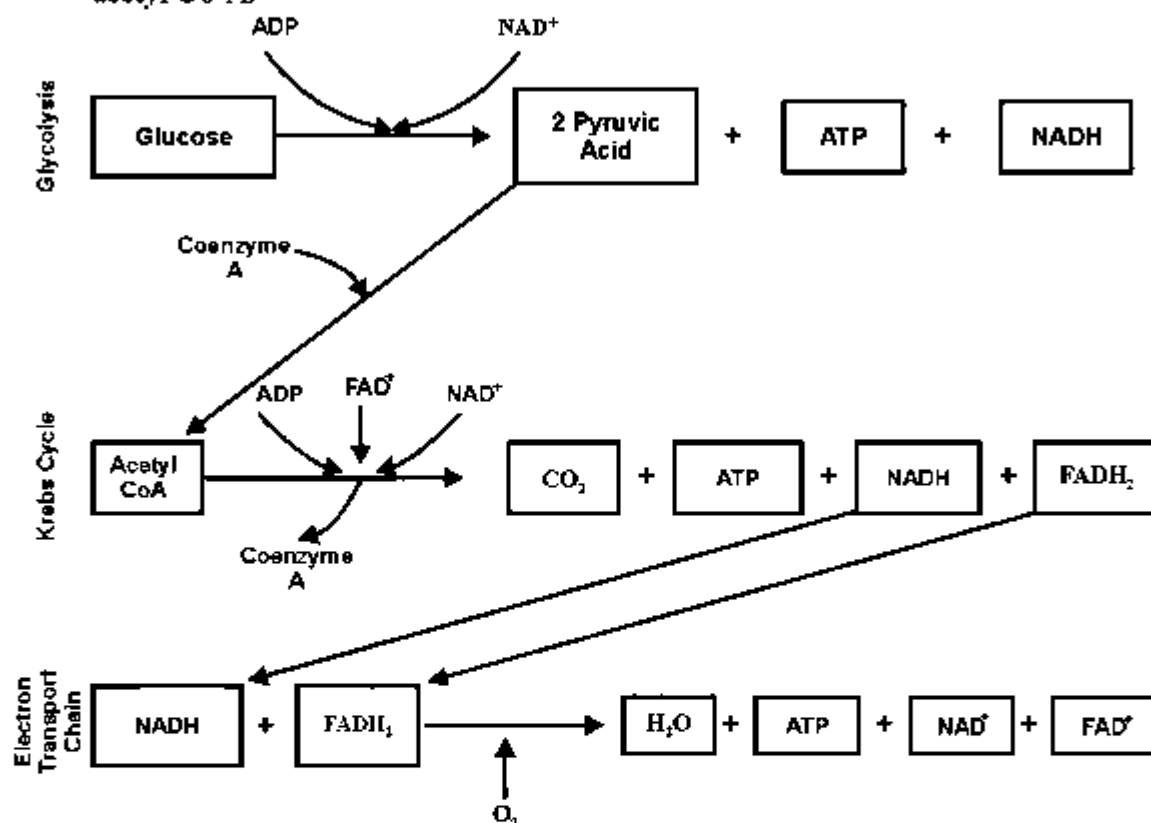


Figure: Mechanism of Respiration

(iii) **Electron Transport Chain:**

Electron transport chain is the final step of cellular respiration. It is the transfer of electron on an electron transport chain.

**Release of Electrons and Hydrogen Ions:**

In this step, NADH and  $\text{FADH}_2$  release electrons and Hydrogen ions.

**Role of Electron Carriers:**

These electrons are taken up by a series of electron carriers.

**Synthesis of ATP:**

When electrons move through the series of electron carriers, they lose energy which is used to synthesize ATP.

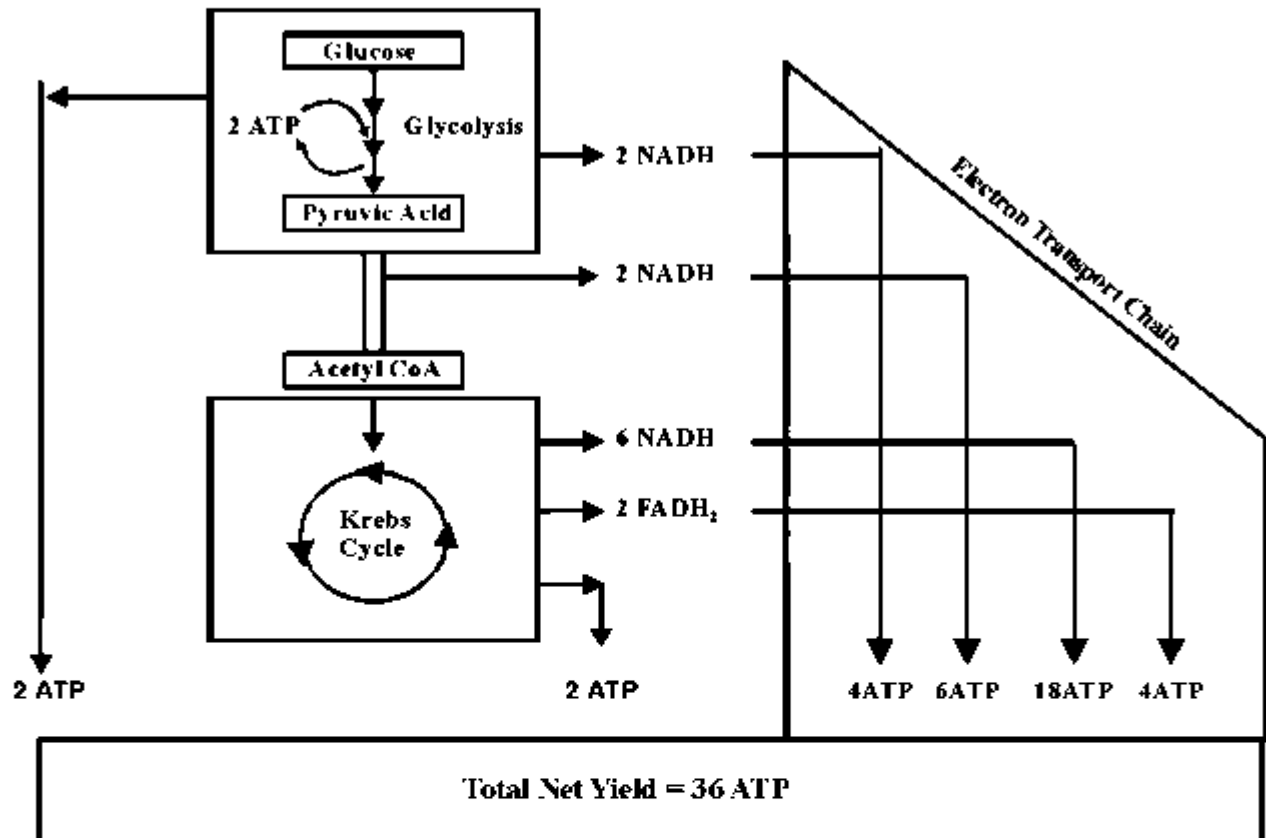
**Formation of Water:**

At the end of chain, electrons and hydrogen ions combine with molecular oxygen and form water.

Ans:

**THE ENERGY BUDGET OF RESPIRATION**

- Each NADH produces 3 ATP in electron transport chain.
- The NADH generated in glycolysis gives 2 ATP, because one ATP is spent to transport it across the mitochondrial membrane.

**Figure: Energy Chart of Respiration**

- Each FADH<sub>2</sub> produces 2 ATP.
- During anaerobic oxidation of glucose only 2 ATP molecules are gained as a net profit. It is because there is no Krebs Cycle and electron transport chain in anaerobic respiration. The total net yield of ATP is 36 molecules.

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## Unit 8: Nutrition

### Short Questions

1. Why does an organism need food?

Text Book Page # 104

**Ans:** Every organism needs food for:

- Growth
- Energy
- Function normally

2. Define nutrition.

(GRW 2013, SGD 2014, 2015)

**Ans:** "The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy is called nutrition".

3. What are nutrients?

**Ans:** "The elements and compounds that an organism obtains and uses for energy or for the synthesis of new materials are called nutrients".

There are two types of nutrients.

- Macronutrients
- Micronutrients

4. Differentiate between nutrient and nutrition.

(LHR 2016)

**Ans:**

NUTRITION	NUTRIENT
<ul style="list-style-type: none"> <li>• The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy, is called nutrition.</li> </ul>	<ul style="list-style-type: none"> <li>• Nutrients are the elements and compounds that an organism obtains and uses for energy or for the synthesis of new materials.</li> </ul>

5. What is the difference between autotrophic and heterotrophic organisms? (LHR 2012)

**Ans:**

AUTOTROPHS	HETEROTROPHS
<ul style="list-style-type: none"> <li>• The organisms which obtain water, carbon dioxide, and minerals from their environment and prepare their food which is then used for growth and energy are called autotrophic organisms.</li> </ul> <p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>• Plants</li> <li>• Some protists</li> <li>• Some bacteria</li> </ul>	<ul style="list-style-type: none"> <li>• The organisms which obtain their food from other organisms and use it for growth and energy are called heterotrophic organisms.</li> </ul> <p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>• Human beings</li> <li>• Animals</li> </ul>



6. What are Macronutrients? Give examples. (LHR 2013, LHR 2014)

Ans: **Macronutrients:**

The nutrients which are required in large quantities are called macronutrients e.g carbon, hydrogen, oxygen, nitrogen, magnesium, potassium etc.

7. What is the difference between macronutrients and micronutrients?

Ans:

MICRONUTRIENTS	MACRONUTRIENTS
<ul style="list-style-type: none"> <li>The nutrients which are required by plants in small quantities are called micronutrients.</li> </ul> <p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>Iron</li> <li>Molybdenum</li> <li>Boron</li> </ul>	<ul style="list-style-type: none"> <li>The nutrients which are required by plants in large quantities are called macronutrients.</li> </ul> <p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>Carbon</li> <li>Hydrogen</li> <li>Oxygen</li> </ul>

8. What is the role of iron and boron in plants life? Text Book Page # 141(GRW 2014)

Ans: **Iron:**

It is necessary for photosynthesis, activates many enzymes.

**Boron:**

Important in sugar transport, cell division, and synthesizing certain enzymes.

9. What is the role of phosphorus and potassium in plant life? (GRW 2015)

Ans: **Phosphorus:**

It is the component of ATP, nucleic acids, coenzymes and is necessary for seed germination, photosynthesis and protein formation.

**Potassium:**

It regulates the opening and closing of the stoma and reduces water loss from the leaves.

10. Discuss the role of nitrogen in plants.

Ans: Nitrogen is a major component of proteins, hormones, chlorophyll, vitamins and enzymes essential for plant life. Nitrogen metabolism is a major factor in stem and leaf growth.

11. Describe the importance of magnesium for plants? (GRW 2013)

Ans: **Importance of magnesium:**

Magnesium is a structural component of chlorophyll. It is also necessary for the functioning of plant enzymes to produce carbohydrates, sugars and fats. It is used for fruit and nut formation and essential for germination of seeds. Deficiency of magnesium causes yellowing and wilting of leaves.

12. Why carnivorous plants have evolved mechanisms for trapping animals?

Ans: Carnivorous plants have evolved mechanisms for trapping and digesting small animals. The products of this digestion are used to supplement plant's supply of nitrogen.

**13. Define fertilizers.**

**Text Book Page # 142**

**Ans:** "As humans cultivated plants, it was learned that addition of certain materials to soil sometimes resulted in plant with desirable characteristics (e.g. more fruit, faster growth, more attractive flowers). Such materials were named as fertilizers".

- Fertilizers are broadly classified as organic or inorganic.

**14. What are the different types of fertilizers?**

**(LHR 2013)**

**Or**

**Differentiate between organic and inorganic fertilizers.**

**(LHR 2014)**

**Ans:** Fertilizers are broadly classified as organic or inorganic.

**(i) Inorganic Fertilizers:**

Naturally occurring inorganic fertilizers include rock phosphate, elemental sulfur and gypsum. These are not chemically modified. If nitrogen is main element, they are called nitrogen fertilizers.

**(ii) Organic Fertilizers:**

They are derived from plant and animal materials. They are more complex and take time to be broken down into forms useable by plants. Manure and compost are the major organic fertilizers.

**15. Explain with example that distinction between organic and inorganic fertilizers is not always clear cut.**

**(LHR 2013)**

**Ans:** The distinction between the organic and inorganic fertilizers are not always clear-cut. Urea, for example, is an organic compound, but chemically synthesized urea is generally grouped with inorganic fertilizers.

**16. Define Eutrophication.**

**(GRW 2014, SGD 2015)**

**Ans:** "Increase in chemical nutrients in an ecosystem is called eutrophication"

The massive quantities of inorganic fertilizers affect the soil nutrient-holding capacity. Their high solubilities also degrade ecosystems through eutrophication.

**17. What are some of environmental hazards related to nitrogen fertilizers?**

**Ans:** Following are the hazards of nitrogen fertilizers.

- Storage and application of some nitrogen fertilizers may cause emissions of greenhouse gas nitrous oxide.
- Excessive nitrogen fertilizers can lead to pest problems by increasing their reproduction rate.

**18. If we supply organic and inorganic fertilizers to a plant, which one would be the first available to the plant for uptake?**

If we supply organic and inorganic fertilizers to a plant, inorganic fertilizer would be the first available to the plant for uptake.

**19. Which nutrients are common source of energy?**

Carbohydrates are the most common source of energy. Proteins and lipids are vital building components for body but they can also be used for energy.

**20. Name the components of human food.**

**Text Book Page # 143**

**Ans:** Like other animals the nutrients used by humans include:

- Carbohydrates
- Lipids
- Nucleic Acids
- Proteins
- Minerals
- Vitamins

**21. What are the differences between saturated and unsaturated fatty acids?**

**(LHR 2014, SGD 2015)**

**Ans:**

<b>SATURATED FATTY ACIDS</b>	<b>UNSATURATED FATTY ACIDS</b>
<ul style="list-style-type: none"><li>• They have all of their carbon atoms bonded to hydrogen atoms.</li><li>• Generally the lipids containing saturated fatty acids are solid at room temperature.</li></ul>	<ul style="list-style-type: none"><li>• They have some of their carbon atoms double bonded in place of a hydrogen atom.</li><li>• The lipids containing unsaturated fatty acids are liquid at room temperature.</li></ul>

**22. What are the sources and uses of lipids?**

**Ans: Sources:**

Important sources of lipids include milk, butter, cheese, eggs, mutton, fish, mustard seeds, coconut and dry fruits.

**Uses:**

Lipids are used to form membranes, the sheaths surrounding neurons and certain hormones. Lipids are also extremely useful energy sources.

**23. Write the main food sources of proteins in human diet.**

**(LHR 2014, 2016)**

**Ans: Sources of Proteins**

Dietary sources of proteins are meat, eggs, grains, legumes, and dairy products such as milk and cheese.

**24. Define Minerals.**

**Text Book Page # 144**

**Ans:** Minerals are inorganic elements that originate in the earth and cannot be made in body. They play important roles in various body functions and are necessary to maintain health. Minerals are of two types:

- (i) Major Minerals
- (ii) Trace Minerals

25. Differentiate between major minerals and trace minerals.

Ans:

MAJOR MINERALS	TRACE MINERALS
<ul style="list-style-type: none"> <li>• They are required in the amounts of 100mg or more per day.</li> </ul> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Sodium</li> <li>• Potassium</li> <li>• Chloride</li> </ul>	<ul style="list-style-type: none"> <li>• They are required in the amounts less than 100mg per day.</li> </ul> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Iron</li> <li>• Zinc</li> <li>• Copper</li> </ul>

26. What is the role of chloride and zinc in human diet? Text Book Page # 145

Ans: Chloride:

Following are the functions of chloride in human diet:

- Fluid balance in the body.
- Component of hydrochloric acid
- Important for muscle contraction
- Nerve impulse transmission
- Heart function and blood pressure

Zinc:

Following are the functions of zinc in human diet:

- Aids in insulin action
- Helps in growth and reproduction
- Acts as enzyme cofactor
- Supports immune function

27. Write importance of calcium. (LHR 2012)

Ans: Role of Calcium

Calcium is essential for the development and maintenance of bones and teeth. It is also needed for maintaining cell membranes and connective tissues and for the activation of several enzymes. Calcium also aids in blood clotting.

28. What is the role of iron in human diet? (LHR 2012)

Ans: Role of Iron

Iron plays a major role in oxygen transport and storage. It is a component of haemoglobin in red blood cells and myoglobin in muscle cells. Cellular energy production also requires iron. It acts as cofactor for many enzymes of cellular respiration. Iron also supports immune function.

29. What can happen if a person's diet is deficient in calcium?

Ans: Deficiency of calcium causes:

- Spontaneous discharge of nerve impulses which may result in tetany.
- Softness of bones.
- Slow blood clotting and wound healing.

**30. How can hypertension and kidney stones be prevented?**

**Ans:** The hypertension and kidney stones can be prevented by intake of:

- Good calcium nutrition
- Low salt
- High potassium

**31. What are vitamins? Which are the two main groups of vitamins? (LHR 2016)**

**Ans: Vitamins:**

“Vitamins are the chemical compounds that are required in low amounts but are essential for normal growth and metabolism”

Vitamins may be divided into two groups.

- (i) Fat - soluble vitamins (Vitamins A, D, E and K)
- (ii) Water - soluble vitamins (Vitamins B and Vitamin C)

**32. Why the level of water-soluble vitamins can decrease more quickly in our bodies?**

**Ans:** Fat-soluble vitamins are much less excreted from body as compared to water-soluble vitamins. So the level of water-soluble vitamins can decrease more quickly in our bodies leading to vitamin deficiencies.

**33. What are the different role of vitamin A in human diet? Text Book Page # 146**

**(RWP 2014)**

**Ans:** Following are the roles of vitamin A:

- It combines with a protein called Opsin to form Rhodopsin in rod cell of the retina of eye.
- It is also involved in cell differentiation, a process through which embryonic cells transforms into mature cells with specific functions.
- Vitamin A also supports bone growth and immune functions.

**34. What can happen due to deficiency of Vitamin A?**

**Ans:** Following are the problems due to deficiency of vitamin A in human diet.

- One of the symptoms of vitamin A deficiency is night blindness.
- Vitamin A deficiency can also cause a condition in which hair follicles become plugged with keratin, giving dry texture to skin.

**35. Which vitamins are destroyed by cooking and heating?**

**Ans:** Cooking or heating destroys water-soluble vitamins more readily than the fat-soluble vitamins.

**36. What are the functions of vitamin C in human beings?**

**(LHR 2016)**

**Ans:** Following are the functions of vitamin C:

- It is needed to form collagen (a fibrous protein) that gives strength to collective tissues.
- Vitamin C in white blood cells enables the immune system to function properly.

**37. What is Scurvy? Write down its symptoms.**

**(RWP 2015)**

**Ans:** The disease known as scurvy results from lack of vitamin C. In this condition the synthesized collagen is unstable. Its symptoms are:

- Muscle and joint pain.
- Swollen and bleeding gums.
- Slow wound healing
- Dry skin

**38. What are sources of vitamin C?**

**(GRW 2014)**

**Ans: Sources of Vitamin C**

We get vitamin C from citrus fruits (e.g. oranges, lemons, and grape fruit), leafy green vegetables, beef liver etc.

**39. Write sources of vitamin D.**

**(GRW 2012, LHR 2012, 2015)**

**Ans: Vitamin D:**

Vitamin D is mainly found in fish liver oil, milk, ghee, and butter etc. It is also synthesized by skin when ultraviolet (UV) radiations from the Sun are used to convert a compound into vitamin D.

**40. What are the diseases caused due to deficiency of vitamin D?**

**Text Book Page # 147 (RWP 2015)**

**Ans: Long term deficiency of vitamin D affects bones.**

**Rickets:**

In children vitamin D deficiency leads to rickets, a condition in which bones weaken and bow under pressure.

**Osteomalacia:**

In adults, vitamin D deficiency causes osteomalacia, or "softening bones", increasing the risks for fracture in bones.

**41. Enlist functions, deficiencies and sources of vitamin A in form of table.**

**Ans:**

VITAMINS	SOURCES	FUNCTIONS	DEFICIENCY SYMPTOMS
Vitamin A	<ul style="list-style-type: none"> <li>• Leafy vegetables (Spinach, carrots)</li> <li>• Yellow Fruits</li> <li>• Fish</li> <li>• Liver</li> <li>• Egg, Milk, butter</li> </ul>	<ul style="list-style-type: none"> <li>• Vision in dim light</li> <li>• Cell differentiation</li> <li>• Growth</li> <li>• Immunity</li> </ul>	<ul style="list-style-type: none"> <li>• Poor growth</li> <li>• Dry Skin</li> <li>• Blindness</li> </ul>

**42. What are dietary fibres? Text Book Page # 150 (LHR 2014, 2015, GRW 2015)**

**Ans:** Dietary fibre (also known as "roughage") is the part of human food that is indigestible. It is found only in plant foods and it moves undigested through stomach and small intestine and into colon. Fibre prevents and relieves constipation by stimulating the contraction of intestinal muscles. Avoiding constipation reduces the risk of many other diseases.

**43. What is the difference between soluble and insoluble dietary fibre?**

**Ans:**

<b>SOLUBLE DIETARY FIBRE</b>	<b>INSOLUBLE DIETARY FIBRE</b>
<ul style="list-style-type: none"><li>• It break down as it passes through alimentary canal.</li><li>• Its sources are oats, beans, barley and many fruits and vegetables.</li></ul>	<ul style="list-style-type: none"><li>• It travels quickly through small intestines.</li><li>• Its sources are wheat bran, serials and skins of many fruits and vegetables.</li></ul>

**44. What are benefits of fibre supplements?**

**Ans:** Fibre prevents and relieves constipations by stimulating the contractions of intestinal muscles. Avoiding constipation reduces the risk of many other diseases. Soluble fibre helps in lowering blood cholesterol and sugar levels. Insoluble fibre speeds up the movement of carcinogens (cancer causing agents) from intestine.

**45. Define balanced diet. Text Book Page # 151 (GRW 2012, LHR 2016)**

**Ans:** "A balanced diet may be defined as the one which contains all the essential nutrients in correct proportion for the normal growth and development of body".

- A balanced diet is related to one's age, gender and activity.

**46. What is relation of balanced diet with age of living organisms?**

**Ans:** Relations with age:

During growth period of the body, there is higher metabolic rate in body cells and so body needs a balanced diet that contains more energy. Adults need less proteins per kilogram body weights, but a growing boy or girls needs more proteins per kilogram weight. Similarly children need more calcium and iron for their growing bones and red blood cells respectively.

**47. Define Malnutrition. Text Book Page # 153**

**Ans:** "Problems related to nutrition are grouped as malnutrition".

It often refers to under-nutrition resulting from inadequate consumption, poor absorption, or excessive loss of nutrients. Malnutrition also includes over-nutrition, resulting from over eating or excessive intake of specific nutrients.

**48. What are the effects of malnutrition?**

**Ans:** The effects of malnutrition are as follow:

- (i) Weakens the immune-system
- (ii) Impairs physical and mental health
- (iii) Slows thinking
- (iv) Stunts growth
- (v) Affects fetal development

**49. What is the major cause of mortality in children?**

**Ans:** According to the United Nations Children's Fund, (UNICEF), malnutrition contributes to deaths of more than 6 million children under age five every year.

**50. What is Marasmus? Text Book Page # 154 (LHR 2013, GRW2013)**

**Ans:** It is a conditions due to Protein-Energy Malnutrition.  
Marasmus usually develops between the ages of six months and one year. Patients lose all their body fat and muscle strength, and acquire a skeletal appearance. Children with marasmus show poor growth and look small for their age.

**51. What do you know about Goiter? / What is its cause? (LHR 2013, GRW 2013)**

**Ans:** Goiter is a condition caused by an insufficient amount of iodine in diet. Iodine is used by thyroid gland to produce hormones that control the body's normal functioning and growth. If sufficient iodine is not available in a person's diet, thyroid gland becomes enlarged and it results in swelling in neck. This condition is known as goiter.

**52. Write down the name of two diseases caused by minerals deficiency. (LHR 2016)**

**Ans:** Following are the diseases caused by minerals deficiency.

- Goiter
- Anaemia

**53. What is meant by OIN? Text Book Page # 155**

**Ans:** Over-intake of nutrients (OIN) is a form of malnutrition in which more nutrients are taken than the amounts required for normal growth, development and metabolism. The effects of over-intake of nutrients are usually intensified when there is reduction in daily physical activity (decline in energy expenditure).

- Over-take of nutrients causes a number of health problems i.e. obesity, diabetes and cardiovascular problems.

**54. Define Starvation. (GRW 2013)**

**Ans: Starvation:**

Starvation is a severe reduction in the nutrient and energy intake and is the most horrible effect of malnutrition. In humans, prolonged starvation causes permanent organ damage and eventually results in death.

**55. What are different effects of Malnutrition?**

**Ans:** An extended period of malnutrition can lead to problems like starvation, heart diseases, constipation and obesity.

**Starvation:**

Starvation is a severe reduction in nutrient and energy intake and is the most horrible effect of malnutrition.

**Heart diseases:**

Heart diseases are also increasing on the global level. One of the causes of heart diseases is malnutrition.

**Constipation:**

Irregularity in meals results in many health problems including constipation.

**Obesity:**



People who take food that contains energy more than their requirement and do very little physical work can become obese.

**56. Define Famine and also tell its causes.**

**Text Book Page # 156**

**Ans:** "Famine means the lack of enough food to feed all people living in an area".

The most terrible famines of the twentieth century are the Ethiopian famine (1983-85) and the North Korean famine (1990s).

**Causes:**

The major causes of famine are

- Unequal distribution of food
- Drought
- Flooding
- Increasing population.

**57. What do you know about World Food Program?**

**Ans:** The world food program (WFP) is the food aid branch of the United Nations. It is the world's largest agency providing food to more than 90 million people in 80 countries.

**58. How flooding becomes a cause of Famine?**

**Ans:** It occurs due to more than normal rainfall or due to weak water distribution system. Rivers and canals overflow their banks and destroy the soil quality of agricultural lands. It becomes impossible to grow crops immediately after flooding. In this way, flooding may be a reason for short-term famine.

**59. What is meant by drought?**

**Text Book Page # 157 (RWP 2015)**

**Ans:** "A drought is a period of time when there is not enough water to support agricultural and human needs".

Drought is usually due to a long period of below-normal rainfall. Drought decreases or even stops the crop yields and it results in famine.

**60. Why digestion is required for human beings?**

**Ans:** Amino acids, simple sugars and fatty acids are rare in our environment. Such substances are usually parts of larger molecules like proteins, polysaccharides and lipids, which cannot cross the membranes. There is a need of converting such large and non-diffusible molecules into smaller and diffusible molecules (that can cross the membrane). This is achieved through the process of digestion.

**61. Write a brief summary of the phases of digestion.**

**Ans:** Digestion comprises following phases:

(i) **Ingestion:**

The process of taking in food.

(ii) **Digestion:**

The process of breaking up complex substances into simpler substances.

**(LHR 2013)**

(iii) **Absorption:**

Diffusion of digested food into blood and lymph.

- (iv) **Assimilation:**  
Conversion or incorporation of absorbed simple food into the complex substances constituting the body.
- (v) **Defecation:**  
Elimination of undigested food from the body.

**62. Define Alimentary Canal. Write down its parts. Text Book Page # 158 (SGD 2015)**

**Ans:** "The digestive system of human consists of a long tube that extends from mouth to anus this tube is called alimentary canal".

- Its main sections are oral cavity, pharynx, esophagus, stomach, small intestines and larger intestine.
- In addition, there are many glands associated with alimentary canal. These are in the form of three pairs of salivary glands, a pancreas and a liver.

**63. How Food is Lubricated and Digested in oral cavity? Text Book Page # 159**

**Ans: Lubrication of food:**

The chewing process stimulates the three pairs of salivary glands (under tongue, behind jaws, and in front of ears) to release a juice called saliva in oral cavity. Saliva adds water and mucous to food which act as lubricant to ease the passage of food through esophagus.

**Digestion:**

Saliva also contains an enzyme salivary amylase, which helps in the semi-digestion of starch.

**64. What is bolus? (GRW 2012, RWP 2015)**

**Ans: Bolus:**

During the processes of chewing, lubrication and semi-digestion, the pieces of food are rolled up by the tongue into small, slippery, spherical mass called bolus.

**65. Define peristalsis? Text Book Page # 160 (GRW 2012)**

**Ans:** "Peristalsis is defined as the waves of contraction and relaxation in the smooth muscles of alimentary canal walls".

- Peristalsis moves food from oral cavity to rectum.

**66. What is role of Gastric glands in stomach?**

**Ans:** When food enters stomach, the gastric glands found in the stomach wall are stimulated to secrete gastric juice.

Gastric juice is composed of

- Mucous
- Hydrochloric acid
- A protein-digesting enzyme pepsinogen.

**67. Pepsin is a powerful protein-digesting enzyme. Why does it not digest stomach walls which are mostly proteins?**

**Ans:** Pepsin is not released in its active form. It is secreted as inactive pepsinogen, which requires HCl for activation. The mucous of gastric juice forms a thick coating over the

inner walls of stomach and neutralizes the HCl there. It makes pepsinogen difficult to be activated, and to attack stomach walls.

**68. What is chyme? (LHR 2015, RWP 2015)**

**Ans:** "When the starch in our bite of bread and the protein in mutton have been partially digested and the food has been converted to a soup-like mixture called chyme".

**69. How gastric juice is secreted? Text Book Page # 161**

**Ans:** Some quantity of gastric juice is always present in stomach. When a bite is in oral cavity, the brain sends messages to stomach walls to secrete some gastric juice. When food reaches stomach, more gastric juice is secreted according to needs. If there is little or no protein in food, stomach does not secrete more juice. On the other hand if more proteins are present in food, abundant gastric juice is secreted. In this case, the already present gastric juice begins digestion of huge proteins into peptides.

**70. What is gastrin:**

**Ans:** The peptides formed from the breakdown of proteins in stomach stimulate some cells of stomach walls to release a hormone called gastrin. This hormone enters blood and is distributed to all parts of body. In stomach it has a specific effect and stimulates the gastric glands to secrete more gastric juice.

**71. What is the role of bile and pancreatic juice in digestion?**

**Ans:** Following are the roles of bile and pancreatic juice in digestion.

**Bile:**

Bile from liver helps in the digestion of lipids through emulsification i.e. by keeping the lipid droplets separate from one another.

**Pancreatic juice:**

Pancreatic juice from pancreas contains enzymes trypsin, pancreatic amylase and lipase which digest proteins, carbohydrates and lipids respectively.

**72. What are villi? Text Book Page # 162 (GRW 2014)**

**Ans:** There are circular folds in the inner wall of ileum. These folds have numerous finger-like projections called villi (singular: villus). Villi increase the surface area of the inner walls and it helps a lot in the absorption of digested food. Each villus is richly supplied with blood capillaries and a vessel of lymphatic system, called lacteal.

**73. What is appendix? (GRW 2014)**

**Ans:** A non-functional finger-like process called appendix arises from the blind end of caecum.

**Appendicitis:**

Appendicitis is the inflammation of the appendix which causes severe pain and may burst in severe cases and the infection may spread in the abdomen.

**Treatment:**

The infected appendix must be removed surgically.

**74. What are the functions of large intestine?**

**Text Book Page # 163 (LHR 2013)**

**Ans:** The functions of large intestine include:

- The elimination of faeces
- Absorption of water & salts

**75. How vitamin K is produced?**

**Ans:** Many bacteria live in colon. They produce vitamin K, which is necessary for the coagulation of blood.

**76. What are bile pigments?**

**Ans:** Bile contains pigments that are by-products of red blood cell destruction in liver. These bile pigments are eliminated from body with faeces.

**77. Write the weight and size of liver in an adult human.**

**Text Book Page # 164**

**(LHR 2016)**

**Ans:** In an adult human, liver weighs about 1.5kg and is the size of a football.

**78. Enlist some functions of liver other than digestion.**

**Ans:** Besides digestion, liver carries out a number of other functions, some of which are summarized here;

- Removes amino groups from amino acids (de-amination).
- Converts ammonia to a less toxic form i.e urea.
- Destroys the old red blood cells.
- Manufactures blood clotting proteins called fibrinogen.

**79. What are the harmful effects of carbonated soft drinks? Text Book Page # 166**

**Ans:** There is a growing concern about the harmful effects of carbonated soft drinks. They are very acidic and make our body poor in oxygen. They contain phosphoric acid, which dissolves calcium out of the bones. This results in bone weakening. The caffeine present in colas increases the heart rate and raises blood pressure.

**80. Discuss treatment of Diarrhoea.**

**Ans:** If sufficient food and water is available, the patient of diarrhoea recovers in a few days. However, for malnourished individuals diarrhea can lead to severe dehydration and can become life-threatening. The treatment for diarrhea involves consuming adequate amounts of water (to replace the loss), preferable mixed with essential salts and some amount of nutrients. Antibiotics may be required if diarrhea is due to bacterial infection.

**81. Define constipation and also tell its main causes.**

**(SGD 2015, RWP 2014)**

**Ans:** Constipation is a condition where a person experiences hard faeces that are difficult to eliminate.

**Causes:**

The main causes of constipation include excessive absorption of water through colon, insufficient intake of dietary fibre, dehydration, use of medicines (e.g. those containing iron, calcium, and aluminum) and tumors in rectum or anus.

**82. What are the causes and symptoms of peptic ulcer? (GRW 2012)**

**Ans: Causes:**

The causes of ulcer include excess acid, infection, long term use of anti-inflammatory medicines (including aspirin), smoking, drinking coffee, colas, and eating spicy foods.

**Symptoms:**

The signs and symptoms of ulcer include abdominal burning after meals or at midnight. Severe ulcers may cause abdominal pain, rush of saliva after an episode of regurgitation, nausea, loss of appetite and weight loss.

**83. Write the reasons of stomach ulcer? (RWP 2015)**

**Ans: Stomach Ulcer:**

In ulcer, the acidic gastric juice gradually breaks down the tissue of the inner wall. Ulcer of stomach is called gastric ulcer. The causes of ulcer include excess acid, infection, long term use of anti-inflammatory medicines (including aspirin), smoking, drinking coffee, colas, and eating spicy foods.

**84. What treatment would you suggest to a patient of constipation and peptic ulcer if you become doctor in future?**

**Ans: Ulcer:**

Ulcer is treated with medicines, which neutralize the acidic affects of gastric juice. Spicy, acidic foods and smoking should be avoided as preventive measures.

**Constipation:**

Treatment of constipation is with a change in dietary and exercise habits. The medicines called laxatives (e.g. paraffin) are used for treatment. Constipation is usually easier to prevent than to treat. One should take the required quantities of water and dietary fibres.

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## Unit 8: Nutrition

### Multiple Choice Questions

1. Which one is a macronutrient? Text Book Page#140  
(a) Iron (b) Magnesium  
(c) Copper (d) Boron
2. Which of the following is a micronutrient? (SGD 2015)  
(a) Potassium (b) Sulphur  
(c) Copper (d) Calcium
3. The micronutrient that is required by plants for nitrogen metabolism: Text Book Page#141  
(a) Chlorine (b) Iron  
(c) Zinc (d) Nickel
4. The functions of Phosphorus are:  
(a) It is component of ATP, Nucleic Acids, coenzymes.  
(b) It is necessary for seed germination.  
(c) Photosynthesis and protein formation.  
(d) All of these
5. Plants get nitrogen in the form of:  
(a) Nitrites (b) Nitrates  
(c) Nitric Acid (d) All of these
6. Deficiency of which element causes the yellowing of leaves in plants? (LHR 2013, BWP 2015)  
(a) Zinc (b) Magnesium  
(c) Copper (d) Chlorine
7. Which one is an organic fertilizer? Text Book Page#142  
(a) Rock phosphate (b) Elemental sulphur  
(c) Compost (d) Gypsum
8. The increase in the chemical nutrients in an ecosystem is called:  
(a) Absorption (b) Assimilation  
(c) Eutrophication (d) Nutrition
9. Which of the following are the most common source of energy? Text Book Page#143  
(SWL 2014, LHR 2015)  
(a) Carbohydrates (b) Lipids  
(c) Proteins (d) All of these
10. How much energy is provided by one gram of carbohydrates? (SWL 2014, LHR 2015)  
(a) 1000 calories (b) 2000 calories  
(c) 3000 calories (d) 4000 calories
11. The lipids are composed of:  
(a) Fatty acids (b) Glycerol  
(c) Both (a) & (b) (d) None of these
12. How much energy is provided by one gram of lipids? (DGK 2015, BRW 2014, LHR 2013)  
(a) 6000 calories (b) 7000 calories  
(c) 8000 calories (d) 9000 calories
13. How much saturated fatty acids are present in butter?  
(a) 40 % (b) 50 %  
(c) 60 % (d) 70 %

14. How much unsaturated fatty acids are present in sunflower oil?  
 (a) 55 % (b) 65 %  
 (c) 75 % (d) 85 %
15. The amount of energy provided by one gram of protein? (GRW 2015)  
 (a) 2000 calories (b) 4000 calories  
 (c) 5000 calories (d) 7000 calories
16. Which of the following major component of food is needed as the main structural component of the body?  
 (a) Carbohydrates (b) Lipids  
 (c) Proteins (d) Vitamins
17. Proteins are also the major components of:  
 (a) Muscles (b) Ligaments  
 (c) Tendons (d) All of these
18. Which of the following is a major mineral? Text Book Page#144  
 (a) Iron (b) Zinc  
 (c) Copper (d) Calcium
19. The minerals required for fluid balance in the body:  
 (a) Sodium (b) Potassium  
 (c) Chloride (d) All of these
20. Which mineral is essential for development and maintenance of bones and teeth? (FSD 2014)  
 (a) Potassium (b) Sodium  
 (c) Iodine (d) Calcium
21. The functions of calcium:  
 (a) Development and maintenance of bones and teeth  
 (b) Blood clotting  
 (c) Oxygen transport and storage  
 (d) Both (a) and (b)
22. Which one is trace mineral?  
 (a) Sodium (b) Potassium  
 (c) Chromium (d) Magnesium
23. The mineral that stabilizes bone mineral and hardens tooth enamel:  
 (a) Iodine (b) Fluoride  
 (c) Zinc (d) Potassium
24. Which one trace mineral is required for normal thyroid function?  
 (a) Iron (b) Zinc  
 (c) Copper (d) Iodine
25. The deficiency of which mineral causes anaemia?  
 (a) Calcium (b) Iron  
 (c) Sodium (d) Magnesium
26. Which of the following is not fat soluble vitamin? (LHR 2014)  
 (a) A (b) B  
 (c) D (d) E
27. Water soluble vitamin is: (SGD 2015, RWP 2015)  
 (a) A (b) B  
 (c) K (d) D
28. The first fat-soluble vitamin identified in 1913: Text Book Page#145  
 (a) A (b) D  
 (c) K (d) C
29. Which vitamin converts opsin into rhodopsin?  
 (a) A (b) C  
 (c) D (d) E



30. Night blindness is caused by the deficiency of: (BWP 2014, SGD 2015)  
 (a) Vitamin A (b) Vitamin B  
 (c) Vitamin C (d) Vitamin D
31. Poor Growth, blindness and dry skin are the deficiency symptoms of: (Text Book Page#146)  
 (a) Vitamin E (b) Vitamin D  
 (c) Vitamin B (d) Vitamin A
32. The deficiency of vitamin C results in: (GRW 2014)  
 (a) Poor growth (b) Scurvy  
 (c) Osteomalacia (d) Rickets
33. Scurvy is caused due to deficiency of \_\_\_\_\_ in body: (LHR 2016)  
 (a) Protein (b) Vitamin C  
 (c) Vitamin D (d) Lipids
34. Vitamin C is needed:  
 (a) To form collagen (b) Healing of wounds  
 (c) Immune system (d) All of these
35. Which vitamin is synthesized by skin exposed to ultraviolet radiations of the sun?  
 (a) A (b) B  
 (c) C (d) D
36. Deficiency of vitamin D leads to: (GRW 2015)  
 (a) Rickets (b) Osteomalacia  
 (c) Scurvy (d) Both (a) and (b)
37. How much of the adult human body is composed of water? Text Book Page#150  
 (a) 40 % (b) 50 %  
 (c) 60 % (d) 70 %
38. The estimated water requirement of an average adult per day:  
 (a) 1 litre (b) 2 litres  
 (c) 3 litres (d) 4 litres
39. Which one is an insoluble dietary fibre? (SWL 2014)  
 (a) Cereals (b) Oats  
 (c) Beans (d) Barley
40. Which of the following is the soluble dietary fibre?  
 (a) Wheat bran (b) Cereals  
 (c) Barley (d) Both (a) and (b)
41. A balanced diet is related to one's: Text Book Page#151  
 (a) Age (b) Gender  
 (c) Activity (d) All of these
42. The percentage of carbohydrates in bread:  
 (a) 42 % (b) 52 %  
 (c) 62 % (d) 65 %
43. The percentage of carbohydrates in potato:  
 (a) 19 % (b) 21 %  
 (c) 31 % (d) 41 %
44. The percentage of lipids in chicken:  
 (a) 10 % (b) 11 %  
 (c) 12 % (d) 13 %
45. How much % of lipids is present in milk? (LHR 2014)  
 (a) 10% (b) 12%  
 (c) 9% (d) 4%
46. The percentage of proteins in egg:  
 (a) 13 % (b) 15 %  
 (c) 17 % (d) 19 %

47. The diseases of Kwashiorkor and Marasmus may be due to:  
 (a) Over intake of nutrients (b) Mineral deficiency  
 (c) Ulcer (d) Protein energy malnutrition
48. Kwashiorkor is a protein deficiency disease that takes place at the age of:  
 (a) 4 months (b) 6 months  
 (c) 8 months (d) 12 months  
 Text Book Page#154
49. Marasmus is due to the deficiency of:  
 (a) Proteins (b) Minerals  
 (c) Vitamins (d) All of these
50. Goitre is due to the deficiency of:  
 (a) Protein (b) Iron  
 (c) Iodine (d) None of these
51. Which disease is caused due to the deficiency of iodine?  
 (DGK 2014, 2015, LHR 2016, GRW 2015)  
 (a) Anaemia (b) Goiter  
 (c) Scurvy (d) Rickets
52. High intake of carbohydrates and fats leads to:  
 (a) Obesity (b) Diabetes  
 (c) Cardiovascular problems (d) All of these  
 Text Book Page#155
53. Which of the following is known as the mother disease?  
 (a) Starvation (b) Heart disease  
 (c) Obesity (d) Constipation
54. The most terrible famines of twentieth century are:  
 (a) Ethiopian Famine (b) North Korean Famine  
 (c) Somalian Famine (d) Both (a) and (b)  
 Text Book Page#156
55. The process of taking in food:  
 (a) Ingestion (b) Digestion  
 (c) Absorption (d) Defecation  
 Text Book Page#157 (GRW 2015)
56. The elimination of undigested food from the body:  
 (a) Absorption (b) Assimilation  
 (c) Defecation (d) Digestion  
 Text Book Page#158 (LHR 2014)
57. The grinding of food by teeth is called.  
 (a) Chewing (b) Mastication  
 (c) Lubrication (d) Both (a) and (b)  
 (SGD 2014)
58. Which part of food is semi digested in oral cavity?  
 (a) Starch (b) Lipids  
 (c) Proteins (d) All of these
59. In adult human oesophagus is about:  
 (a) 10cm (b) 15cm  
 (c) 20 cm (d) 25 cm  
 (FSD 2014)
60. The wave of contraction and relaxation in the smooth muscles of alimentary canal:  
 (a) Lubrication (b) Mastication  
 (c) Food selection (d) Peristalsis  
 Text Book Page#159 (SWL 2016)
61. When the direction of peristalsis reverses, it results:  
 (a) Swallowing (b) Vomiting  
 (c) Chewing (d) Lubrication
62. In stomach, Pepsinogen is converted into:  
 (a) Pepsin (b) Bicarbonates  
 (c) HCl (d) Gastrin  
 (FSD 2015, SGD 2015, MTN 2014)

63. Which acid is present in pepsin? (MTN 2015)  
 (a)  $H_2SO_4$  (b)  $H_2CO_3$   
 (c)  $HNO_3$  (d) HCl
64. Gastric juice is composed chiefly of: Text Book Page#160  
 (a) Mucous (b) Hydrochloric Acid  
 (c) Pepsinogen (d) All of these
65. The length of duodenum in adult human: Text Book Page#161  
 (a) 10 cm (b) 15 cm  
 (c) 25 cm (d) 35 cm
66. Which of the following enzyme is present in Bile?  
 (a) Amylase (b) Lipase  
 (c) Pepsin (d) None of these
67. Pancreatic juice from pancreas contains enzymes:  
 (a) Trypsin (b) Pancreatic amylase  
 (c) Lipase (d) All of these
68. The pancreas produces digestive enzymes and releases them into: (GRW 2013)  
 (a) Colon (b) Gall bladder  
 (c) liver (d) Duodenum
69. The length of jejunum in adult human:  
 (a) 2.1 meter (b) 2.2 meter  
 (c) 2.3 meter (d) 2.4 meter
70. The length of ileum in adult human: (GRW 2015)  
 (a) 1.5 meters (b) 2.5 meters  
 (c) 3.5 meters (d) 4.5 meters
71. The circular folds in the inner wall of ileum have numerous finger-like projections called:  
 (a) Villi (b) Lacteal  
 (c) Blood capillaries (d) Appendix
72. Where are villi found? (LHR 2015, GRW 2014, BWP, FSD 2015)  
 (a) Stomach (b) Small intestine  
 (c) esophagus (d) Large intestine
73. In which part of the alimentary canal, the maximum absorption of nutrients occur?  
 Text Book Page#161 (MTN 2014)  
 (a) Stomach (b) Small intestine  
 (c) Large intestine (d) All of these
74. Which part of gut absorbs water? (GRW 2014)  
 (a) Stomach (b) Large intestine  
 (c) Rectum (d) Duodenum
75. The part of the large intestine in which maximum absorption of water take place:  
 (a) Caecum (b) Colon  
 (c) Rectum (d) None of these
76. A non-functional finger-like process:  
 (a) Villi (b) Lacteal  
 (c) Blood capillaries (d) Appendix

77. Functions of the large intestine include: Text Book Page#163  
 (a) The elimination of faeces (b) Absorption of water  
 (c) Absorption of Salts (d) All of these
78. Faeces are temporarily stored in: (SGD 2014)  
 (a) Appendix (b) Rectum  
 (c) Gall bladder (d) Pancreas
79. Which vitamin is made by bacteria in colon? (RWP 2015)  
 (a) Vitamin C (b) Vitamin D  
 (c) Vitamin E (d) Vitamin K
80. The largest gland of human's body is:  
 (a) Liver (b) Pancreas  
 (c) Thyroid (d) Parathyroid
81. In an adult human, the weight of liver: (DGK 2015)  
 (a) 1 kg (b) 1.5 kg  
 (c) 2 kg (d) 2.5 kg
82. The function of bile is: Text Book Page#154  
 (a) De- amination (b) Emulsification of lipids  
 (c) Detoxification (d) All of these
83. Diarrhoea is caused by: Text Book Page#166  
 (a) Virus (b) Bacteria  
 (c) Lack of safe water (d) All of these
84. The medicines used for treatment of constipation:  
 (a) laxatives (b) Paraffin  
 (c) Aspirin (d) Both (a) & (b)
85. In which of the following peptic ulcer occur?  
 (a) Oesophagus (b) Duodenum  
 (c) Stomach (d) All of these

#### ANSWERS KEY

1	b	11	c	21	d	31	d	41	d	51	b	61	b	71	a	81	b
2	c	12	d	22	c	32	b	42	b	52	d	62	a	72	b	82	b
3	d	13	d	23	b	33	b	43	a	53	c	63	d	73	b	83	d
4	d	14	c	24	d	34	d	44	b	54	d	64	d	74	b	84	d
5	b	15	b	25	b	35	d	45	d	55	a	65	c	75	b	85	d
6	b	16	c	26	b	36	d	46	a	56	c	66	d	76	d		
7	c	17	d	27	b	37	c	47	d	57	d	67	d	77	d		

8	c	18	d	28	a	38	b	48	d	58	a	68	d	78	b	
9	a	19	d	29	a	39	a	49	a	59	d	69	d	79	d	
10	d	20	d	30	a	40	c	50	c	60	d	70	c	80	a	

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## Unit 8: Nutrition

### Long Questions

**Q.1** Describe mineral nutrition in plants. Text Book Page # 140+141

**Ans:** MINERAL NUTRITION IN PLANTS

**Mode of Nutrition:**

Plants have the most efficient mechanisms for autotrophic mode of nutrition.

**Requirement of Nutrients:**

Plants get carbon, hydrogen, and oxygen from carbon dioxide and water. In addition to these elements, plants also require mineral elements for various activities and structures.

**Types of Nutrients:**

There are two types of nutrients required by plants:

(i) **Macronutrients:**

The nutrients which are required by plants in large quantities are called macronutrients.

**Example:**

Carbon, hydrogen, oxygen, nitrogen, magnesium, potassium, etc.

(ii) **Micronutrients:**

The nutrients which are required by plants in small quantities are called micronutrients.

**Example:**

Iron, molybdenum, boron, chlorine, zinc, etc.

#### ROLE OF IMPORTANT NUTRIENTS IN PLANT LIFE

MACRONUTRIENTS	ROLE IN PLANT LIFE
<b>Phosphorus</b>	<ul style="list-style-type: none"> <li>• Component of ATP, Nucleic acids, Co-enzymes,</li> <li>• Necessary for seed germination, photosynthesis,</li> <li>• Protein formation,</li> </ul>
<b>Potassium</b>	<ul style="list-style-type: none"> <li>• Regulates the opening &amp; closing of stomata,</li> <li>• Reduces water loss from leaves</li> </ul>
<b>Sulphur</b>	<ul style="list-style-type: none"> <li>• Component of Proteins, Vitamins, Enzymes</li> </ul>
<b>Calcium</b>	<ul style="list-style-type: none"> <li>• Activates enzymes</li> <li>• Structural component of cell wall</li> <li>• Influences water movement in cells</li> </ul>

MICRONUTRIENTS	ROLE IN PLANT LIFE
<b>Iron</b>	<ul style="list-style-type: none"> <li>• Necessary for photosynthesis</li> <li>• Activates many enzymes</li> </ul>
<b>Molybdenum</b>	<ul style="list-style-type: none"> <li>• Component of the enzyme that reduces nitrates to ammonia</li> <li>• Important in building amino acids</li> </ul>
<b>Boron</b>	<ul style="list-style-type: none"> <li>• Important in sugar transport, cell division and</li> <li>• Synthesizing certain enzymes</li> </ul>
<b>Copper</b>	Component of several enzymes

<b>Manganese</b>	• Involved in enzyme activity for photosynthesis, Respiration and nitrogen metabolism
<b>Zinc</b>	Required in a large number of enzymes.
<b>Chlorine</b>	Involved in osmosis of water
<b>Nickel</b>	Required in nitrogen metabolism.

**Lack of Nutrients:**

If any of these nutrients is not available to plant, they show abnormalities and do not grow normally.

**Q.2 Discuss role of nitrogen and magnesium in plants.**

**Text Book Page # 141**

**(MTN 2015)**

**Ans:**

**ROLE OF NITROGEN**

Plants get nitrogen in the form of nitrates. Nitrogen metabolism is a major factor in stem and leaf growth.

**Major Component:**

Nitrogen is a major component of the following which are highly essential for plant life:

- (i) Proteins
- (ii) Hormones
- (iii) Chlorophyll
- (iv) Vitamins
- (v) Enzymes

**Excessive Nitrogen:**

Too much nitrogen can delay flowering and fruiting.

**Deficiency:**

Deficiency of nitrogen can:

- Reduce yields
- Cause yellowing of leaves
- Stunt growth

**Carnivorous plants:**

Carnivorous plants have evolved mechanisms for trapping and digesting small animals. The products of this digestion are used to supplement the plant's supply of nitrogen.

**ROLE OF MAGNESIUM****Functions:**

- Magnesium is a structural component of Chlorophyll.
- It is necessary for the functioning of plant enzymes to produce carbohydrates, sugars and fats.
- It is used for fruit and nut formation.
- It is essential for the germination of seeds.

**Deficiency:**

Deficiency of Magnesium causes yellowing and wilting of leaves.



**Q.3 Define fertilizers and describe their importance.**

**Text Book Page # 142  
(GWR 2015, LHR 2016)**

**Ans: FERTILIZERS**

**Fertilizers:**

As humans cultivated plants, it was learned that addition of certain materials to soil sometimes resulted in plants with desirable characteristics. Such materials were named as fertilizers.

**Desirable Characteristics:**

- More fruit
- Faster growth
- More attractive flowers

**Types of Fertilizers:**

Fertilizers are broadly classified into two types:

- (i) Inorganic Fertilizers
- (ii) Organic Fertilizers

#### **INORGANIC FERTILIZERS**

Naturally occurring inorganic fertilizers include:

- Rock Phosphate
- Elemental Sulfur
- Gypsum

They are not chemically modified.

**Nitrogen Fertilizers:**

If nitrogen is the main element, they are called nitrogen fertilizers.

**Properties:**

- Most inorganic fertilizers dissolve readily in water.
- They are immediately available to plants for uptake.

#### **ORGANIC FERTILIZERS**

**Source:**

The organic fertilizers are derived from plant and animal materials.

**Properties:**

They are more complex and take time to be broken down into forms reusable by plants.

**Benefits:**

They increase soil drainage, aeration and the ability of the soil to hold nutrients.

**Examples:**

These include:

- Manure
- Compost

**Unclear Distinction between Inorganic and Organic Fertilizers:**

The distinction between organic and inorganic fertilizers is not always clear-cut. Urea, for example, is an organic compound, but chemically synthesized urea is generally grouped with inorganic fertilizers.

**Q.4 Enlist and explain environmental hazards related to fertilizers use.**

**Text Book Page # 142 (DGK 2014)**

**Ans: ENVIRONMENTAL HAZARDS RELATED TO FERTILIZERS USE**

**(i) Effect on Soil:**

Massive quantities of inorganic fertilizers affect the soil nutrient-holding capacity.

**(ii) Eutrophication:**

Their high solubilities degrade ecosystems through eutrophication, which is the increase in chemical nutrients in an ecosystem.

**(iii) Green House Gases:**

Storage and application of some nitrogen fertilizers may cause emission of the green house gas, nitrous oxide. Ammonia gas may be emitted from inorganic fertilizers.

**(iv) Reproduction Rate of Pests:**

Excessive nitrogen fertilizers lead to pest problems by increasing their reproduction rate.

**(v) Environmental Problems:**

Excessive amounts of organic fertilizers cause environmental problems due to nitrate leaching, or run off of soluble organic compounds.

**RECOMMENDATION FOR USE**

It is recommended that the nutrient content of the soil and nutrient requirements of the crop should be calculated before the application of inorganic fertilizers.

**Q.5 Define nutrients. Also explain carbohydrates and lipids. Text Book Page # 143**

**(MTN 2014, 2015)**

**Ans: CARBOHYDRATES**

**Energy source:**

Carbohydrates are the basic source of energy for all organisms. About half to 2/3 of the total calories every animal consumes daily are from carbohydrates.

**Examples:**

Glucose is the most often used carbohydrate for energy. Other useful carbohydrates are:

- Maltose
- Lactose
- Sucrose
- Starch

**Energy Content:**

- Carbohydrates contain 4 kilocalories per gram.

**Sources:**

Humans get carbohydrates from foods like

- Bread
- Pastas
- Beans
- Potatoes
- Bran
- Rice
- Cereals

**LIPIDS**

**(LHR 2013, GWR 2014)**

**Composition:**

The lipids present in food are composed of fatty acids bonded to glycerol.

**Types of Fatty Acids:**

The fatty acids present in lipids are of two types:

**(i) Saturated Fatty Acids:**

Saturated fatty acids have all of their carbon atoms bonded to hydrogen atoms. Lipids containing saturated fatty acids are solid at room temperature.

**Example:**

Butter contains 70% saturated and 30% unsaturated fatty acids.

**(ii) Unsaturated Fatty Acids:**

Unsaturated fatty acids have some of their carbon atoms double-bonded in place of a hydrogen atom. Lipids containing unsaturated fatty acids are liquid at room temperature.

**Example:**

Sunflower oil contains 75% unsaturated fatty acids.

**Functions:**

Lipids are used to form:

- Membranes
- Sheaths surrounding neurons
- Certain hormones

**Energy source:**

Lipids are extremely useful energy sources.

**Energy content:**

One gram of lipids contains 9 kilocalories of energy.

**Sources:**

Important sources of lipids include:

- Milk
- Butter
- Cheese
- Eggs
- Mutton
- Fish
- Mustard seeds
- Coconut
- Dry fruits

**Q.6 Describe the role of proteins and minerals in human diet.**

**(GWR 2014)**

**Ans:**

**PROTEINS****Composition:**

Proteins are composed of amino acids.

**Functions:**

They are essential components of:

- Cytoplasm
- Membranes
- Organelles

- Muscles
- Ligaments
- Tendons

So, we use proteins for growth. Many proteins play role as enzymes.

**Energy source:**

They can also be used for gaining energy. They can be converted into carbohydrates.

**Energy Content:**

One gram of proteins contains 4 kilocalories of energy.

**Sources:**

Dietary sources of proteins include:

- Meat
- Eggs
- Grains
- Legumes
- Dairy products such as milk and cheese

### **MINERALS**

**Definition:**

Minerals are inorganic elements that originate in the earth and cannot be made in the body.

**Functions:**

They play roles in various body functions and are necessary to maintain health.

**Sources:**

Most of the minerals in human diet come directly from:

- Plants
- Water
- Animal foods

**Types of Minerals:**

Minerals are categorized into:

**(i) Major Minerals:**

The minerals that are required in amounts of 100 mg (milligrams) or more per day are called major minerals.

**(ii) Trace Minerals:**

The minerals that are required in amounts less than 100 mg per day are called trace minerals.

### **IMPORTANT MINERALS IN HUMAN DIET AND THEIR ROLES**

<b>MAJOR MINERALS</b>		<b>ROLE IN BODY</b>
<b>Sodium</b>	Fluid balance in the body Helps in absorption of other nutrients	Important for Muscle contraction, Nerve impulse transmission, Heart function and Blood pressure
<b>Potassium</b>	Fluid balance in the body Acts as cofactor for enzymes	
<b>Chloride</b>	Fluid balance in the body Compo of hydrochloric acid	
<b>Calcium</b>	Development and maintenance of bones and teeth Blood clotting	

<b>Magnesium and phosphorus</b>	Development and maintenance of bones and teeth	
<b>TRACE MINERALS</b>		
<b>Iron</b>	Oxygen transport and storage	Act as enzyme cofactors Support immune function
<b>Zinc</b>	Aids insulin action, Helps in growth and reproduction	
<b>Copper</b>	Acts as enzyme cofactor	
<b>Chromium</b>	Helps in insulin action	
<b>Fluoride</b>	Stabilizes bone mineral and hardens tooth enamel	
<b>Iodine</b>	Essential for normal thyroid function	

**Q.7 Describe role of calcium and iron in humans.**

**Text Book Page # 145**

**(GWR 2013, LIIR 2014, 2015, 2016)**

**Ans:**

### **ROLE OF CALCIUM**

#### **Functions:**

- (i) Calcium is essential for the development and maintenance of bones and teeth.
- (ii) It is needed for maintaining cell membranes and connective tissues.
- (iii) It is needed for activation of several enzymes.
- (iv) It also aids in blood clotting.
- (v) Good calcium nutrition, along with low salt and high potassium intake, prevents from hypertension and kidney stones.

#### **Sources:**

Humans get calcium from

- Milk
- Cheese
- Egg yolk
- Beans
- Nuts
- Cabbage

#### **Deficiency:**

- (i) Deficiency of calcium causes spontaneous discharge of nerve impulses which may result in tetany.
- (ii) Bones become soft.
- (iii) Blood clots slowly.
- (iv) Wounds heal slowly.

### **ROLE OF IRON**

#### **Functions:**

- (i) Iron plays a major role in oxygen transport and storage.
- (ii) It is a component of haemoglobin in red blood cells.
- (iii) It is a component of myoglobin in muscle cells.
- (iv) Cellular energy production also requires iron.
- (v) It acts as a co-factor for many enzymes of cellular respiration.
- (vi) It also supports immune-function.

#### **Sources:**

Humans get iron from:

- Red meat
- Egg yolk
- Whole wheat
- Fish
- Spinach
- Mustard

**Deficiency:**

Its deficiency is the most common nutrient deficiency worldwide. Iron deficiency causes anaemia.

**Q.8 What are vitamins? Describe the role of vitamin A in humans. Text Book Page # 145 (LHR 2014)**

**Ans:**

**VITAMIN**

**Definition:**

Vitamins are the chemical compounds that are required in low amounts but are essential for normal growth and metabolism. Vitamins may be divided into two groups:

- The fat-soluble vitamins (vitamins A, D, E and K)
- The water-soluble vitamins (vitamins B and vitamin C).

**VITAMIN A**

Vitamin A was the first fat-soluble vitamin, identified in 1913.

**Functions**

- It combines with a protein called opsin to form rhodopsin in rod cells of the retina of eye.
- It is involved in cell-differentiation, a process through which embryonic cells transform into mature cells with specific functions.
- It also supports bone growth and immune functions.

**Sources:**

Humans get Vitamin A from

- Leafy vegetables (spinach, carrots)
- Yellow/orange fruits (mango)
- Liver
- Fish
- Eggs
- Milk
- Butter

**Deficiency:**

- Deficiency of vitamin A is the leading cause of blindness in children worldwide.
- One of the symptoms of vitamin A deficiency is night blindness. When vitamin A is inadequate, the lack of rhodopsin makes it difficult to see in dim light. It is a temporary condition, but if left untreated, it can cause permanent blindness.
- Vitamin A deficiency can also cause a condition in which hair follicles become plugged with keratin, giving dry texture to skin.

**Q.9 Write a note on vitamin C.**

**Text Book Page # 146**

**Ans:**

**VITAMIN-C**

**(LHR 2014)**

Other name of vitamin C is ascorbic acid.

**Functions:**

- Vitamins C participates in many reactions.
- It is needed to form collagen (a fibrous protein) that gives strength to connective tissues. Collagen is also needed for wound healing.
- Vitamin C in white blood cells enables the immune system to function properly.

**Sources:**

Humans get Vitamin C from

- Citrus fruits (oranges, lemons, grape-fruit)
- Leafy green vegetables
- Beef liver
- Minute quantities of vitamin C are present in muscles. Since meat consists of muscles so it is not a good source of vitamin C.

**Deficiency:**

- Deficiency of Vitamin C causes connective tissue changes throughout the body.
- The disease known as scurvy results from lack of vitamin C. In this condition the synthesized collagen is unstable. Symptoms of scurvy include:

- (i) Muscle and joint pain
- (ii) Swollen and bleeding gums
- (iii) Slow wound healing
- (iv) Dry skin

**Q.10 Write a note on vitamin D.**

**(LHR 2014)**

**Ans:**

**VITAMIN D**

**Function:**

The best-known function of vitamin D is to help regulate blood levels of calcium and phosphorus. Vitamin D increases the absorption of these minerals from intestine and their deposition in bones.

**Sources:**

Vitamin D is mainly found in:

- Fish liver oil
- Milk
- Ghee
- Butter

**Synthesis:**

It is also synthesized by skin when ultraviolet (UV) radiations from the sun are used to convert a compound into vitamin D.

**Deficiency:**

Long-term deficiency of vitamin D affects bones.

**Rickets:**

In children, vitamin D deficiency leads to rickets, a condition in which bones weaken and bow under pressure.

**Osteomalacia:**

In adults, vitamin D deficiency causes osteomalacia, or “soft bones,” increasing the risk of fractures in bones.

**Q.11 Describe effect of water and dietary fibre on life of human beings.**

**Text Book Page # 150 (LHR 2012, 2013, 2015, GWR 2014)**

**Ans:**

**WATER**

Strictly speaking, water and dietary fibre are not considered as nutrients, but they do play important role in life.

**Percentage Composition:**

Approximately 60% of the adult human body is composed of water.

Following are the functions of water in human bodies:

**Metabolism:**

Nearly all life-sustaining chemical reactions require an aqueous (watery) environment.

**Absorption:**

Water functions as the environment in which water-soluble food stuff is absorbed in the intestines.

**Excretion:**

The waste products are eliminated in the urine through water.

**Sweating:**

An essential role of water is to maintain body temperature through evaporation, as in sweating.

**Deficiency:**

Severe dehydration may result in cardiovascular problems.

**Daily Requirement:**

The estimated water requirement of an average adult is two litres per day.

**Sources:**

Important sources of daily water intake are:

- Natural water
- Milk
- Juicy fruits
- Vegetables

**DIETARY FIBRE****Other Name:**

Dietary fibre is also known as roughage.

**Introduction:**

Dietary fibre is the part of human food which is indigestible. It is found only in plant foods and it moves undigested through stomach and small intestine into colon.

**Types:**

Dietary fibre is of two types:



(i) **Insoluble Dietary Fibre:**

The insoluble dietary fibre travels quickly through small intestine.

**Sources:**

The sources of insoluble dietary fibre are:

- Wheat bran
- Cereals
- Skins of many fruits and vegetables

(ii) **Soluble Dietary Fiber:**

The soluble dietary fibre breaks down as it passes through the alimentary canal.

**Sources:**

The sources of soluble dietary fibre are:

- Oats
- Beans
- Barley
- Many fruits and vegetables

**Functions:**

- Fiber prevents and relieves constipation by stimulating the contraction of intestinal muscles. Avoiding constipation reduces the risk of many other diseases.
- Soluble fibre helps in lowering blood cholesterol and sugar levels.
- Insoluble fibre speeds up the movement of carcinogens (cancer causing agents) from intestine.

**Precaution for Use:**

Fibre supplements (such as ispaghol husk) should be used only with a physician's recommendations. Taken properly, these supplements may help in constipation and in lowering cholesterol level.

**Q.12 Write a note on balanced diet.**

**Text Book Page # 151**

**Ans: BALANCED DIET**

**Introduction:**

Humans require various types of nutrients in order to keep them healthy and fit. These nutrients should be taken appropriately in diet.

**Definition:**

A diet which contains all the essential nutrients in correct proportion for the normal growth and development of body is called balanced diet.

**Composition:**

The balanced diet should include different types of nutrients and should be according to the energy requirements.

**Relation of Balanced Diet with Age, Gender and Activity:**

A balanced diet is related to one's:

(i) **Age:**

During growth period of the body, there is a higher metabolic rate in body cells and so body needs a balanced diet that contains more energy.

**Adults:**

Adults need less protein per kilogram of body weight.

**Growing Persons:**

A growing boy or girl needs more proteins per kilogram body weight.

**Children:**

Children need more calcium and iron for their growing bones and red blood cells respectively.

**(ii) Gender:**

Gender has an impact on the requirements of a balanced diet.

**Women:**

Women have comparatively less metabolic rate than men of the same age and weight.

**Men:**

So men need a balanced diet that provides comparatively more energy.

**(iii) Activity:**

Different people have different lifestyles and varied nature of work.

- A man with sedentary habits does not require as much energy as a man who is on his feet for most of the day.

The following chart shows some of the common foods, taken in Pakistan and the percentage of carbohydrates, lipids and proteins in each of them.

**COMMON FOODS AND THE PERCENTAGE OF NUTRIENTS**

FOOD	CARBOHYDRATES	LIPIDS	PROTEINS
Bread (Roti)	52%	03%	09%
Rice	23%	0.1%	2.2%
Potato	19%	0.1%	02%
Apple	12.8%	0.5%	0.3%
Eggs	0.7%	12%	13%
Milk	04%	04%	03%
Butter	0.4%	81%	0.6%
Chicken	0	11%	20%

**Q.13** What problems can occur if a person is deficient in balanced diet? Discuss.

Text Book Page # 153

**Ans:**

**PROBLEMS RELATED TO NUTRITION**

**Introduction:**

Problem related to nutrition are grouped as malnutrition. It often refers to under-nutrition resulting from inadequate consumption, poor absorption, or excessive loss of nutrients. Malnutrition also includes over-nutrition, resulting from overeating or excessive intake of specific nutrients.

Common forms of malnutrition include:

1. Protein-energy malnutrition (PEM)
2. Mineral deficiency diseases (MDD)
3. Over-intake of nutrients (OIN)

### **PROTEIN-ENERGY MALNUTRITION** (GWR 2014, LHR 2014)

#### **Definition:**

The inadequate availability or absorption of energy and proteins in the body is called protein-energy malnutrition.

#### **Effects:**

It is the leading cause of death in children in developing countries. It leads to the following diseases:

#### **(i) Kwashiorkor:**

##### **Cause:**

It is due to protein deficiency.

##### **Age:**

It occurs at the age of 12 months, usually when breast-feeding is discontinued. It can also develop at any time during a child's growing years.

##### **Effects:**

Children may grow to a normal height but are abnormally thin.

#### **(ii) Marasmus:**

##### **Age:**

Marasmus usually develops between the ages of six months and one year.

##### **Effects:**

- Patients lose all their body fat and muscle strength, and acquire a skeletal appearance.
- Children with Marasmus show poor growth and look small for their age.



(a)



(b)

Figure: Children suffering from (a) Kwashiorkor (b) Marasmus

### **MINERAL-DEFICIENCY DISEASES**

#### **Definition:**

(SWL 2015)

Diseases resulting from the deficiency of minerals are called mineral deficiency diseases.

- These diseases are relatively rare among humans.

#### **Examples:**

The examples of mineral deficiency diseases are:

#### **(i) Goiter:**

##### **Cause:**

It is caused by an insufficient amount of iodine in diet.

**Functions of Iodine:**

Iodine is used by thyroid gland to produce hormones that control body's normal functioning and growth.

**Deficiency of Iodine:**

If sufficient Iodine is not available in a person's diet, thyroid gland becomes enlarged and it results in a swelling in neck. This condition is known as goiter.

**(ii) Anemia:**

Anemia is the most common of all mineral deficiency diseases.

**Meaning:**

The term 'anemia' literally means 'a lack of blood'.

**Cause:**

It is caused when the number of red blood cells is reduced than the normal. Haemoglobin molecule contains a single atom of iron in the centre. If body fails to receive sufficient amounts of iron, adequate number of haemoglobin molecules is not formed.

**Effects:**

There are not enough functioning red blood cells. The patient is weak and there is shortage of oxygen supply to body cells.

**OVER-INTAKE OF NUTRIENTS****Introduction:**

Over-intake of nutrients (OIN) is a form of malnutrition in which more nutrients are taken than the amounts required for normal growth, development and metabolism.

**Reason:**

The effects of over-intake of nutrients are usually intensified when there is reduction in daily physical activity (decline in energy expenditure).

**Effects:**

Over-intake of nutrients causes a number of health problems.

**Carbohydrates and Fats:**

High intake of carbohydrates and fats leads to:

- Obesity
- Diabetes
- Cardiovascular problems

**Vitamin A:**

High doses of Vitamin A cause:

- Loss of appetite
- Liver problems

**Vitamin D:**

Excessive intake of Vitamin D leads to deposition of calcium in various tissues.

**Q.14** What are the effects of malnutrition?

**Text Book Page # 155**

**(GWR 2013, 2015, LHR 2014, SWL 2014, DGK 2014)**

**Ans:**

**EFFECTS OF MALNUTRITION**

An extended period of malnutrition can lead to problems like:

**(i) Starvation:**

Starvation is a severe reduction in nutrient and energy intake and is the most horrible effect of malnutrition.

**Effects:**

In humans, prolonged starvation causes permanent organ damage and eventually results in death.

According to the Food and Agriculture Organization of the United Nations, more than 25,000 people die of starvation every day. On average, every five seconds a child dies from starvation.

**(ii) Heart Diseases:**

Heart diseases are also rising on the global level.

**Cause:**

One of the causes of heart diseases is malnutrition. People who take unbalanced diet (high in fats) are more exposed to heart problems.

**(iii) Constipation:**

Malnutrition often leads to situations where people can not schedule their meals. This irregularity results in many health problems including constipation.

**(iv) Obesity:**

Obesity means becoming over-weight.

**Cause:**

Obesity is also due to malnutrition. People who take food which contains energy more than their requirement and do very little physical work can become obese.

**Mother-disease:**

Obesity is known as the mother disease as it can give rise to:

- Heart problems
- Hypertension
- Diabetes

**Q.15 Discuss famine as the major cause of malnutrition.**

**Text Book Page # 156 (GWR 2015)**

**Ans: FAMINE – THE MAJOR CAUSE OF MALNUTRITION**

**Definition:**

The lack of enough food to feed all people living in that area is called as famine.

**Examples:**

The most terrible famines of the twentieth century are:

- The Ethiopian famine (1983-85)
- The North Korean famine (1990s)

**Major Causes of Famine:**

The major causes of famines are:

**(i) Unequal Distribution of Food:**

The achievements in science have enabled human beings to produce better food in terms of quality and quantity. Today, the agricultural practices produce more than enough food that can be supplied to everyone on the earth.

### **Cause of Unequal Distribution:**

Due to political and administrative problems, food is not equally distributed to different regions of the world.

### **Effects:**

The result is, there is always surplus food in countries like

- America
- UK
- Canada

And at the same time, people have nothing to eat in countries like

- Ethiopia
- Somalia

### **Role of WFP:**

The World Food Program (WFP) is the food aid branch of United Nations. It is the world's largest agency providing food to more than 90 million people in 80 countries.

### **(ii) Drought:**

A period of time when there is not enough water to support agricultural and human needs is called as drought.

### **Cause:**

Drought is usually due to a long period of below-normal rainfall.

### **Effect:**

Drought decrease or even stop the crop yields and it results in famine.

### **(iii) Flooding:**

Flooding occurs due to:

- More than normal rainfall
- Weak water distribution system

### **Effects:**

Rivers and canals overflow their banks and destroy the soil quality of agricultural lands. It becomes impossible to grow crops immediately after flooding. In this way, flooding may be a reason for short-term famine.

### **(iv) Increasing Population:**

In spite of the global increase in food production, millions of human beings are undernourished. In the over-populated regions of the world, large populations overuse natural resources to grow maximum food in order to meet the problems of food shortage.

### **Effects:**

It leads to dry and infertile lands and depletion of resources. In such situations crops can no longer be grown and famines result.

### **(v) Problems created by Humans:**

Famines may also be due to the problems created by humans like:

- Wars
- Wrong economic policies

**Q.16 Define human alimentary canal and discuss role of oral cavity in digestive system.**

**Text Book Page # 157+158 (BWP 2014)**

**Ans:**

**Human Alimentary Canal**

The digestive system of human consists of a long tube that extends from mouth to anus this tube is called alimentary canal. Its main sections are oral cavity, pharynx, esophagus, stomach, small intestine and large intestine. In addition, there are many glands associated with alimentary canal. These are in the form of three pairs of salivary glands, a pancreas and a liver.

**ORAL CAVITY**

**Location:**

Oral cavity is the space behind mouth.

**Functions:**

The oral cavity has many important functions in the whole process of digestion.

**(i) Food Selection:**

One of the functions of oral cavity is food selection. When food enters oral cavity, it is tasted and felt. If its taste suggests that it is old, we reject it. If teeth or tongue detect some hard object, such as dirt, we also reject that bite.

The sense of smell and vision also help oral cavity in the selection of food.

**(ii) Mastication:**

The second function of the oral cavity is the grinding of food by teeth. This is known as chewing or mastication. This is a useful process because oesophagus can pass only small pieces. Enzymes also can not act on large pieces of food. They require small pieces with large surface area to attack.

**(iii) Lubrication:**

The chewing process stimulates the three pairs of salivary glands (under tongue, behind jaws, and in front of ears) to release a juice called in oral cavity.

**(iv) Role of Saliva:**

Saliva adds water and mucus to food which act as lubricant to ease the passage of food through esophagus.

**(v) Partial Digestion:**

Saliva also contains an enzyme salivary amylase, which helps in the semi-digestion of starch.

**(vi) Bolus Formation:**

During the processes of chewing, lubrication, and semi-digestion, the pieces of food are rolled up by tongue into small, slippery, spherical mass called bolus.

**Swallowing of Bolus:**

The bolus is swallowed and pushed into esophagus through the pharynx.

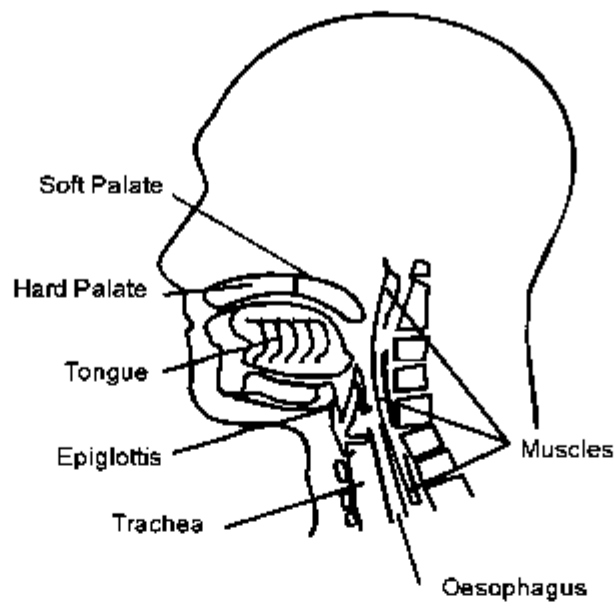


Figure: Parts of Oral Cavity

**Q.17** Describe the role of pharynx and esophagus in swallowing and peristalsis.

Text Book Page # 159

**Ans:**

#### ROLE OF PHARYNX

##### **Role of Tongue:**

During swallowing, bolus is pushed to the back of the mouth by tongue.

##### **Role of Soft Palate:**

- When tongue pushes bolus, the soft palate also moves upward and to rear. In this way, the opening of the nasal cavity is closed.
- When swallowed, the bolus passes pharynx to enter esophagus.

##### **Pharynx:**

Pharynx has adaptations to prevent the entry of bolus particles in trachea (wind-pipe to lungs).

##### **Function:**

During swallowing, larynx (the top of trachea), moves upward and forces the epiglottis (a flap of cartilage) into horizontal position. Thus glottis (the opening of trachea) is closed.

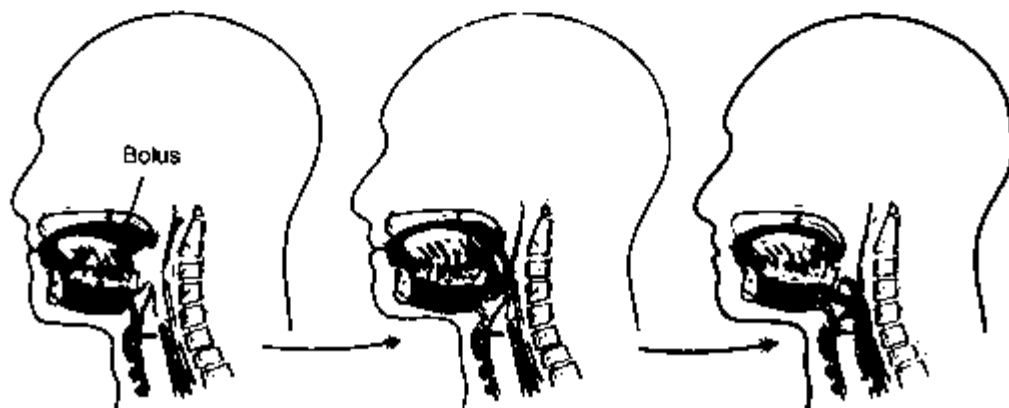


Figure: Steps in Swallowing



### **Control of Swallowing**

The beginning of swallowing action is voluntary, but once food reaches the back of mouth, swallowing becomes automatic.

### **ROLE OF OESOPHAGUS**

#### **Length:**

In humans the esophagus is about 25 cm long.

#### **Role of Esophagus:**

After being swallowed, food enters the tube called esophagus, which connects pharynx to stomach. Neither pharynx nor esophagus contributes to digestion and the previous digestive actions of saliva continue.

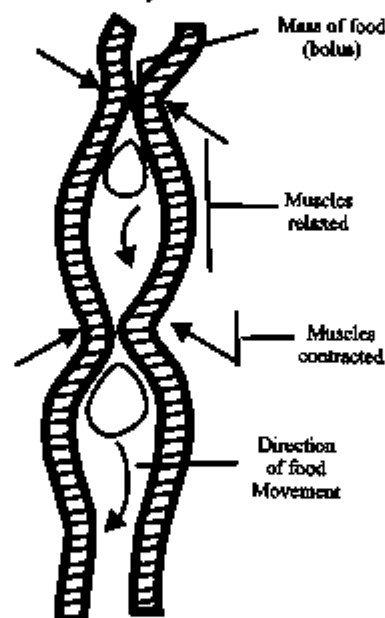
#### **Peristalsis:**

Peristalsis is defined as:

The wave of contraction and relaxation in the smooth muscles of alimentary canal walls is called peristalsis.

#### **Function:**

Peristalsis moves food from oral cavity to rectum.



**Figure: Peristalsis**

**Q.18 Describe the role of stomach in digestion.**

**Text Book Page # 160**

**(LHR 2012, GWR 2015, SWL 2015)**

**Ans:**

**STOMACH (LHR 2013)**

#### **Shape:**

Stomach is a dilated part of alimentary canal. It is J-shaped.

#### **Location:**

It is located in the left of abdomen, just beneath diaphragm.

#### **Main Portions:**

Stomach has two main portions:

#### **(i) Cardiac Portion:**

Cardiac portion is present immediately after esophagus.

**(ii) Pyloric Portion:**

Pyloric portion is located beneath cardiac portion.

**Sphincters:**

Sphincters are the openings which are guarded by muscles.

Stomach has two sphincters:

**(a) Cardiac Sphincter:**

Cardiac sphincter is between stomach and esophagus. Bolus enters stomach from esophagus through cardiac sphincter.

**(b) Pyloric Sphincter:**

Pyloric sphincter is present between stomach and small intestine.

**Functions:**

Stomach performs functions of:

**(i) Digestion:**

When food enters stomach, the gastric glands found in the stomach wall are stimulated to secrete gastric juice.

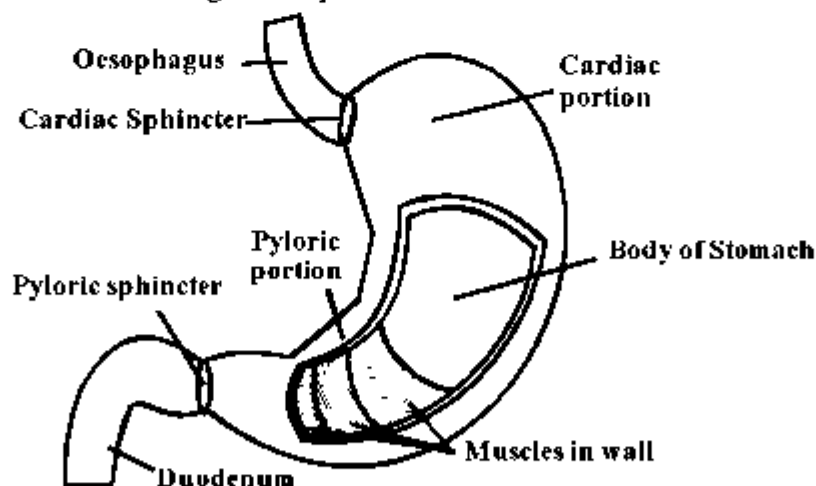
**Components of Gastric Juice:**

Gastric juice is composed chiefly of:

- Mucus
- Hydrochloric Acid
- Pepsinogen (A protein-digesting enzyme)

**Role of HCl**

- Hydrochloric acid converts the inactive enzyme pepsinogen into its active form i.e. pepsin.
- HCl also kills microorganisms present in food.



**Figure: Structure of Stomach**

**Role of Pepsin:**

Pepsin partially digests the protein portion of food into polypeptides and shorter peptide chains.

**Role of Mucus:**

Mucus not only aids in lubrication, but it forms a thick coating over the inner walls of stomach, and protects them from the strong HCl by neutralizing it. Hence pepsinogen cannot be activated to attack stomach walls.

**(ii) Churning and Melting:**

In stomach, food is further broken apart through a process of churning. The walls of stomach contract and relax and these movements help in thorough mixing of gastric juice and food. The churning action also produces heat which helps to melt the lipid content of food.

**Chyme Formation:**

The starch and protein in the food have been partially digested and the food has been converted into a soup-like mixture called chyme. After it, the pyloric sphincter allows a little mass of chyme to enter duodenum.

**Role of Gastrin:**

The peptides stimulate some cells of stomach walls to release a hormone called gastrin. This hormone enters blood and is distributed to all parts of body. In stomach, it has specific effect and stimulates the gastric glands to secrete more gastric juice.

**Q.19 Describe the role of small intestine in digestion. Text Book Page # 161**

**(LHR 2015, DGK 2015)**

**Ans:** **SMALL INTESTINE**

The stomach opens into the small intestine.

**Parts:**

Small intestine has three parts:

**(i) Duodenum:**

Duodenum comprises of the first 10 inches (25cm) of small intestine and it is the part of small intestine where most of the digestive process occurs.

**Functions:**

In small intestine, food is further mixed with 3 different secretions:

**1. Bile:**

Bile from liver helps in the digestion of lipids through the process of emulsification i.e. by keeping the lipid droplets separate from one another.

**2. Pancreatic Juice:**

Pancreatic juice from pancreas contains three enzymes:

- Trypsin digests proteins.
- Pancreatic amylase digests carbohydrates.
- Lipase digests lipids.

**3. Intestinal Juice:**

Intestinal juice from intestine walls contains many enzymes for the complete digestion of all kinds of food.

**(ii) Jejunum:**

Next to the duodenum is jejunum.

**Length:**

It is 2.4 meters long.

**Functions:**

It is concerned with the rest of the digestion of proteins, carbohydrates and lipids.

**(iii) Ileum:**

This is the last part of the small intestine.

**Length:**

It is 3.5 meters long.

**Function:**

It is concerned with the absorption of digested food.

**ROLE OF SMALL INTESTINE IN ABSORPTION**

**Villi:**

There are circular folds in the inner wall of ileum. These folds have numerous finger like projections called villi. The singular of villi is villus.

**Function:**

- Villi increase the surface area of the inner walls.
- They help in the absorption of food.

**Structure of a Villus:**

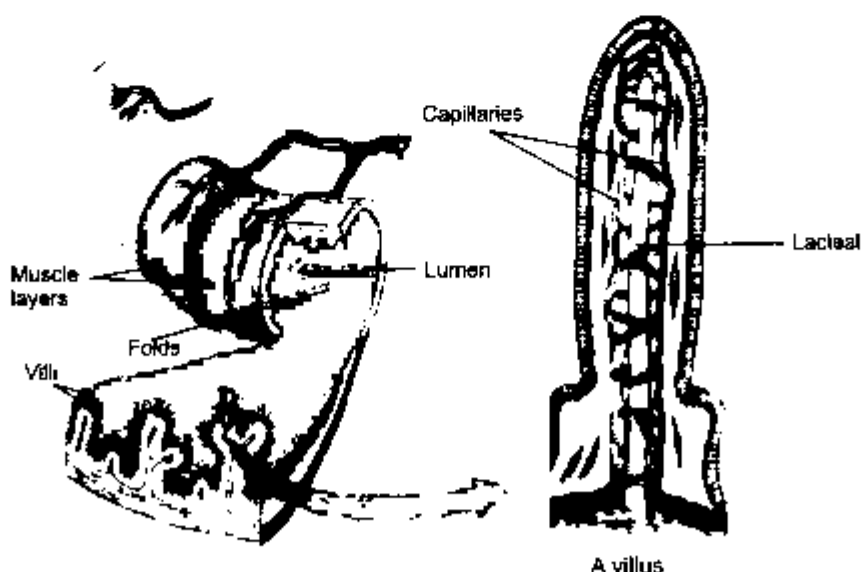
- Each villus is richly supplied with blood capillaries and it has a vessel of lymphatic system called lacteal.
- The walls of a villus are only single cell thick.

**Absorption of Sugars and Amino Acids:**

The digested molecules i.e. simple sugars and amino acids are absorbed from intestine into the blood capillaries present in villi. The blood carries them away from the small intestine via the hepatic portal vein and goes to liver for filtering. Here the toxins are removed and extra food is stored.

**Absorption of Fatty Acids and Glycerol:**

Fatty acids and glycerol are absorbed into the lacteal of villus. The lacteal carries them to the main lymphatic duct, from where they enter in bloodstream.



**Figure: Folds and Villi in Small Intestine**

**Q.20 Describe the role of large intestine in human digestive system. Text Book Page # 162**

**Ans:** **LARGE INTESTINE**

After the digested products of our bite have been absorbed in blood, the remaining mass enters the large intestine.

**Parts:**

Large intestine has three parts:

- (i) Caecum (the pouch that forms T-junction with small intestine).
- (ii) Colon
- (iii) Rectum

**Functions:**

Following are the functions of large intestine,

**(a) Absorption of water:**

From colon, water is absorbed into blood.

**Faeces:**

As water is absorbed, the solid remains of food are called faeces.

**Components of Faeces:**

Faeces mainly consist of:

- Undigested material
- A large number of bacteria
- Dead cells of alimentary canal
- Bile pigments
- Water

**Storage of Faeces:**

Faeces are temporarily stored in the rectum, which opens out through anus.

**(b) Defecation:**

Under normal conditions, when the rectum is filled up with faeces, it gives rise to a reflex and anus is opened for defecation.

**Control of Reflex:**

**In Adults:**

The reflex is consciously inhibited in adults.

**In Infants:**

In infants, it is controlled involuntarily. During growth, child learns to bring this reflex under voluntary control.

**Q.21 Write a note on liver.**

**Text Book Page # 163+164**

**(GWR 2014, SWL 2015, MTN 2015, DGK 2015)**

**Ans:** **LIVER**

**Largest Gland:**

Liver is the largest gland of the body.

**Lobes:**

It is multi-lobed.

**Color:**

It is a dark-reddish in appearance.

**Location:**

It lies beneath the diaphragm, on the right side of abdomen.

**Weight:**

In an adult human, it weighs about 1.5 kg.

**Size:**

It is the size of a football.

**GALL-BLADDER**

**Shape:**

It is pear-shaped.

**Color:**

It is a greenish-yellow sac.

**Location:**

It lies along the right lobe of liver on ventral side.

**BILE JUICE**

Liver secretes bile, which is stored in gallbladder

**Release:**

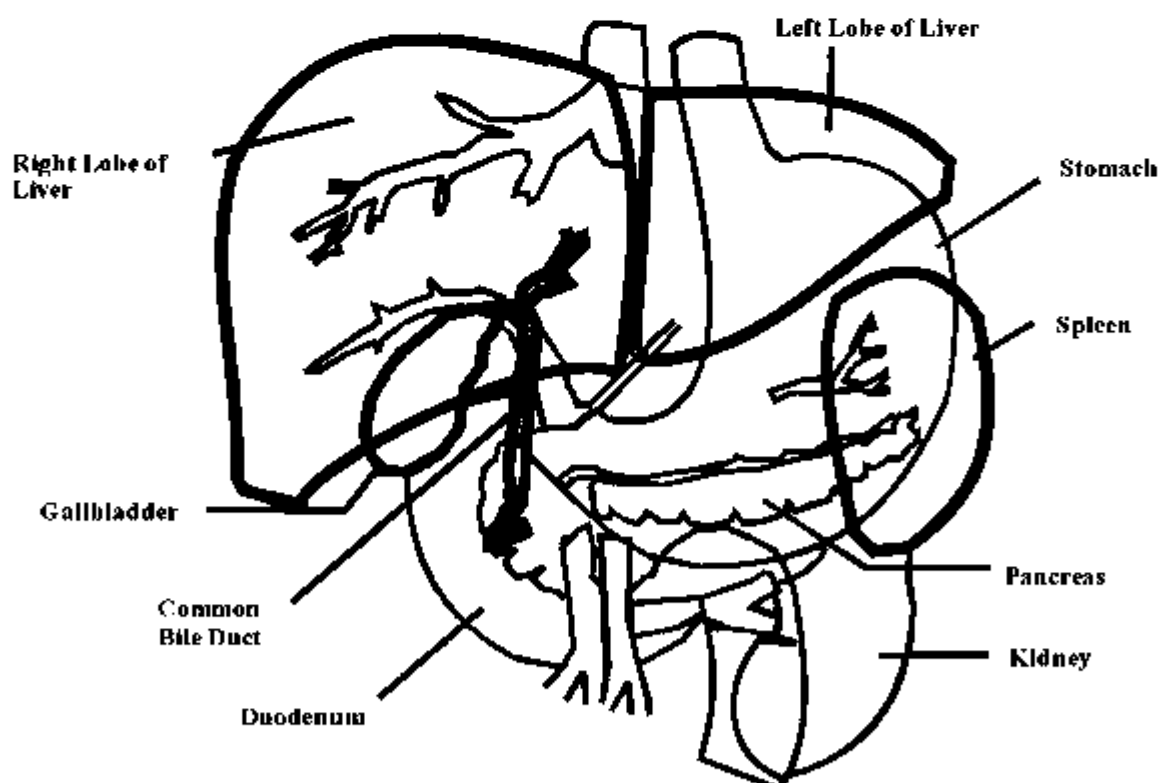
When gallbladder contracts, bile is released into duodenum through common bile duct.

**Composition:**

Bile has no enzymes but contains bile salts for the emulsification of lipids.

**Function:**

It helps the lipid-digesting enzymes to attack on lipids



**Figure: Liver and Associated Organs**

**FUNCTIONS OF LIVER**

Besides digestion, liver carries out a number of other functions, some of which are summarized here:

**(i) De-amination:**

It removes amino-groups from amino-acids.

**(ii) Formation of Urea:**

It converts ammonia to a less toxic form, urea.

**(iii) Destruction of Red blood cells:**

It destroys the old red blood cells.

**(iv) Formation of Fibrinogen:**

It manufactures blood clotting protein called fibrinogen.

**(v) Glucose-Glycogen Interconversion:**

It converts glucose into glycogen and, when required, breaks glycogen into glucose.

**(vi) Cholesterol Formation:**

It converts carbohydrates and proteins into lipids and produces cholesterol.

**(vii) Heat Production:**

It produces heat to maintain body temperature.

**(viii) Storage of Vitamins and Ions:**

It stores fat-soluble vitamins (A, D, E, and K) and mineral ions, such as iron.

**Q.22 Write the names of organs of our digestive system and draw a labeled diagram.**

**Ans:**

**HUMAN DIGESTIVE SYSTEM**

The digestive system of human consists of a long tube that extends from mouth to anus. This tube is called alimentary canal.

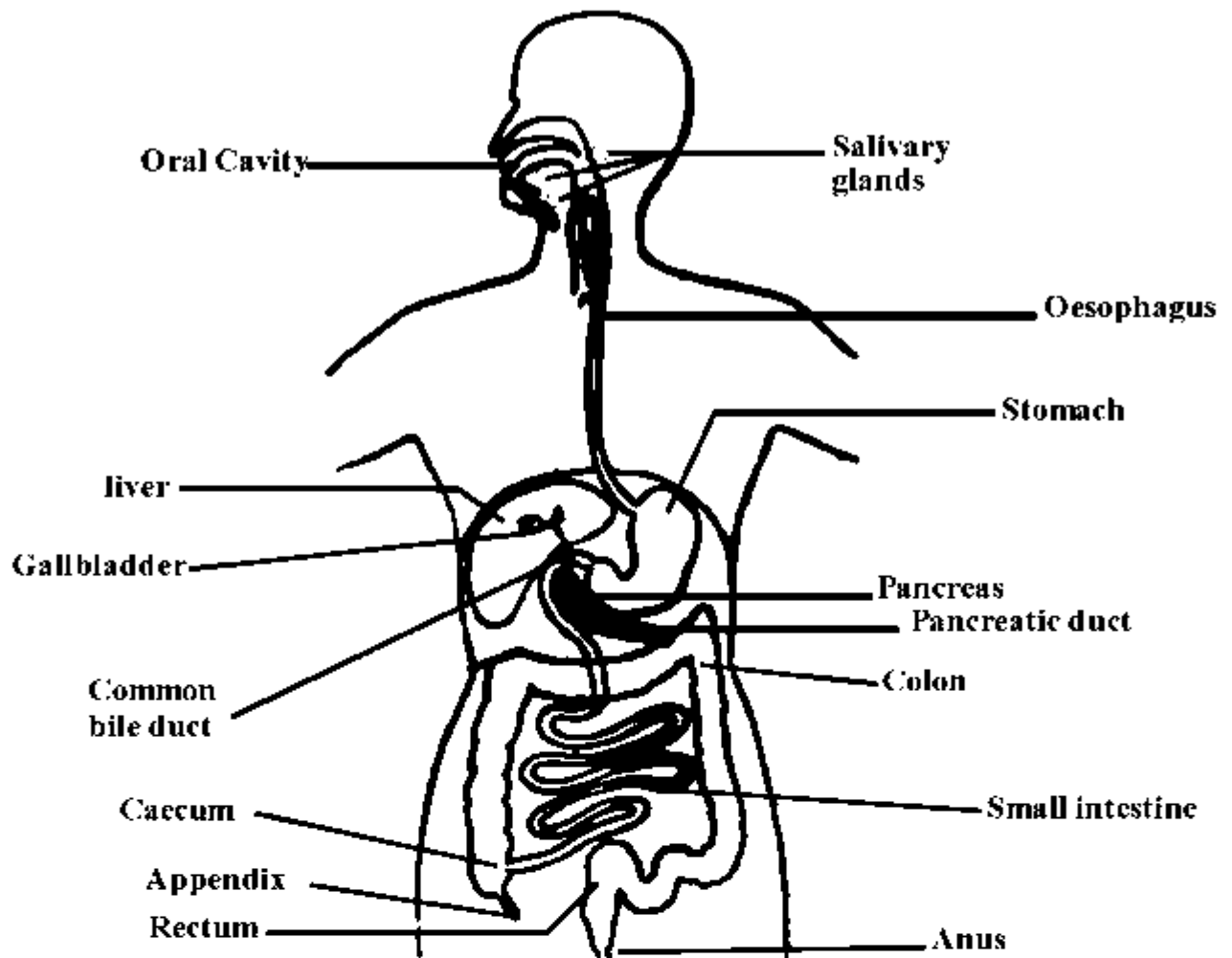
The human digestive system consists of the following organs:

**Main Organs:**

- Oral cavity
- Pharynx
- Oesophagus
- Stomach
- Small intestine
- Large intestine
- Rectum
- Anus

**Glands:**

- Three pairs of salivary glands
- Pancreas
- Liver



**Figure: Human Digestive System**

**Q.23** Describe disorders of the gut. Text Book Page # 165+166 (SWL 2014, MTN 2014)

**Ans:** **DISORDERS OF GUT**

The most common disorders of the gut that affect a number of people in Pakistan are:

1. Diarrhoea
2. Constipation
3. Ulcer

### **DIARRHOEA**

(MTN 2015)

#### **Introduction:**

It is a condition in which the sufferer has frequent watery, loose bowel movements.

#### **Symptoms:**

This condition may be accompanied by

- Loose, watery stools
- Abdominal pain
- Nausea
- Vomiting



**Causes:**

- When required water is not absorbed in blood from colon.
- Lack of adequate safe water.
- Viral or bacterial infections of large intestine.

**Recovery:**

If sufficient food and water is available, the patient of diarrhoea recovers in a few days. However, for malnourished individuals, diarrhoea can lead to severe dehydration and can become life-threatening.

**Treatment:**

The treatment of diarrhoea involves

- Consuming adequate amounts of water (to replace the loss), preferably mixed with some amounts of essential salts and nutrients.
- Antibiotics may be required if diarrhoea is due to bacterial infection

**Prevention:**

Diarrhoea can be prevented by:

- Taking clean water
- Intake of essential salts
- Eating regularly
- Taking hygienic measures

### CONSTIPATION

**Introduction:**

Constipation is a condition where a person experiences hard faeces that are difficult to eliminate.

**Causes:**

The main causes of constipation include:

- Excessive absorption of water through colon
- Insufficient intake of dietary fiber
- Dehydration
- Use of medicines (e.g. those containing iron, calcium, aluminium)
- Tumors in rectum or anus

**Treatment:**

The treatment of constipation includes:

- Changes in dietary and exercise habits
- Use of laxatives (e.g. Paraffin)

**Prevention:**

Constipation is usually easier to prevent than to treat. One should take the required quantities of water and dietary fibres.

### ULCER

(LHR 2014)

**Introduction:**

An ulcer (peptic ulcer) is a sore in the inner wall of gut, i.e., in:

- Esophagus
- Stomach
- Duodenum

In ulcer, the acidic gastric juice gradually breaks down the tissue of the inner mucosal wall.

### **Gastric ulcer:**

Ulcer of stomach is called gastric ulcer.

### **Causes:**

The causes of ulcer include:

- Excess acid
- Infection
- Long term use of anti-inflammatory medicines (including aspirin)
- Smoking
- Drinking coffee
- Drinking colas
- Eating spicy foods

### **Signs and Symptoms:**

The signs and symptoms of ulcer include:

- Abdominal burning after meals or at midnight
- Severe ulcers may cause abdominal pain
- Rush of saliva after an episode of regurgitation
- Nausea
- Loss of appetite
- Weight loss

### **Treatment:**

Ulcer is treated with medicines which neutralize the acidic effects of gastric juice.

### **Preventive Measures:**

The following things should be avoided as preventive measures:

- Spicy foods
- Acidic foods
- Smoking

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## Unit 9: Transport

### Short Questions

**1. Why the cells are regarded as units of life?**

**Text Book Page#171**

**Ans:** Cells are the primary sites for metabolic processes. That is why they are regarded as the 'units of life'.

**2. Why materials are transported to and from cells?**

**Ans:** Complex metabolic reactions occur in living organisms. In order to run their metabolism, cells need some materials from the environment and also need to place some materials into the environment. For this purpose, materials are transported to and from cells.

**3. What is the limitation of phenomenon of diffusion for transport?**

**Ans:** One method for the movement of molecule is diffusion but it alone cannot fulfill the needs. It takes much time for materials in solution to diffuse even a few inches.

**4. Why diffusion can work efficiently in unicellular and simple multicellular organisms?**

**Ans:** Diffusion can work only in unicellular and simple multicellular organisms because every corner of their body is in close and direct contact with the environment.

**5. Why diffusion cannot work efficiently in complex multicellular organisms?**

**Ans:** In complex multicellular bodies, cells are far apart from the environment and such bodies need a comprehensive system for the transport of materials.

**6. What are the functions of roots in plants?**

**Text Book Page#172**

**Ans: Functions of Roots:**

In addition to anchor the plant, roots perform two other vital functions. First; they absorb water and salts from soil. Second; they provide conducting tissues for distributing these substances to the tissues of stem.

**7. What is the difference between xylem and phloem tissues?**

**Ans:**

XYLEM TISSUE	PHILOEM TISSUE
<ul style="list-style-type: none"> <li>• Xylem tissue is responsible for the transport of water and dissolved substances from roots to aerial parts.</li> <li>• It consists of vessel elements and tracheids.</li> </ul>	<ul style="list-style-type: none"> <li>• Phloem tissue is responsible for the conduction of dissolved organic matter (food) between different parts of plant body.</li> </ul>

- |  |  |
|--|--|
|  | <ul style="list-style-type: none"> <li>• It consists of sieve tube cells and companion cells.</li> </ul> |
|--|--|

**8. Discuss role of root hairs in plants for water and ion uptake.**

**Ans:** Root hairs provide large surface area for absorption. They grow out into spaces between soil particles where they are in direct contact with water. The cytoplasm of root hairs has higher concentration of salts than soil water, so water moves by osmosis into root hairs. Salts also enter root hairs by diffusion or active transport.

**9. Define Transpiration.**

**Text Book Page#173**

**(LHR 2012, GRW 2015, DGK 2014, SWL 2015, BWP 2015, FSD 2014, SGD 2015)**

**Ans: Transpiration:**

Transpiration is the loss of water from plant surface through evaporation. This loss may occur through stomata in leaves, through the cuticle present on leaf epidermis, and through special openings called lenticels present in the stems of some plants.

**10. Define stomatal transpiration.**

**(LHR 2014, GRW 2015, DGK 2015)**

**Ans:** Most of the transpiration occurs through stomata and is called stomatal transpiration. The mesophyll cells of leaf provide large surface area for the evaporation of water.

**11. How air movement affects rate of transpiration? Text Book Page#175 (LHR 2012)**

**Ans: Effects of Air Movement:**

Wind (air in motion) carries away the evaporated water from leaves and it causes an increase in the rate of transpiration from the surfaces of mesophyll. When air is still, the rate of transpiration is reduced.

**12. Which factors affect the rate of transpiration?**

**(SWL 2014, LHR 2015)**

**Ans:** Following are some important factors affecting the rate of transpiration:

- Temperature
- Air humidity
- Air movement
- Leaf surface area

**13. Why transpiration is known as necessary evil? Text Book Page#176 (GRW 2014)**

**Ans:** Transpiration is called a necessary evil. It means that transpiration is a potentially harmful process but is unavoidable too.

Transpiration may be a harmful process in the sense that during the conditions of drought, loss of water from plant results in serious desiccation, wilting and often death. On the other hand, transpiration is necessary too. It creates a pulling force called transpirational pull which is principally responsible for the conduction of water and salts.

**14. What is cohesion tension theory?**

**Text Book Page#181**

**(LHR 2012, 2015, SWL 2014, 2015, RWP 2014, SGD 2015)**

**Ans:** According to cohesion tension theory, the force which carries water (and dissolved materials) upward through the xylem is transpirational pull. Transpiration creates a pressure difference that pulls water and salts up from roots.

**15. Define Transpiration pull.**

**Ans:** "When one water molecule moves up in the xylem of the leaf, it creates a pulling force that continues all the way to root. This pulling force created by the transpiration of water is called transpirational pull".

It also causes water move transversely (from root epidermis to cortex and pericycle).

**16. What is the effect of water stress in plants?**

**Ans:** There is strong evidence that even mild water stress results in reduced growth rate in plants.

**17. What are reasons for creation of transpirational pull?**

**Text Book Page#182**

**Ans:** Following are the reasons for the creation of transpirational pull.

- Water is held in a tube (xylem) that has small diameter.
- Water molecules adhere to the walls of xylem tube (adhesion).
- Water molecules cohere to each other (cohesion).

**18. How food is transported in different parts of plants?**

**Text Book Page#183**

**Ans:** Transport of food is through pressure-flow mechanism. In pressure-flow mechanism, food is moved from sources to sinks.

**19. What is difference between sources and sinks?**

**Text Book Page # 184**

**Ans: Sources:**

Sources include the exporting organs, typically a mature leaf or storage organ.

**Sinks:**

Sinks are the areas of active metabolism or storage e.g. roots, tubers, developing fruits and leaves, and growing regions.

A storage organ is capable of storing food and exporting the stored materials.

**Example:**

Root of beet is a sink in first growing season, but becomes source in next growing season, when sugars are utilized in the growth of new shoots.

**20. Discuss direction of transport of food and salts in plants.**

**Ans: One way street:**

Xylem is a one way street from roots to leaves for water and salts.

**Two way Street:**

Phloem is a two way street for food. The direction of the movement of food is decided by supply and demand in sources and sinks.

**21. Give an example that plants need a lot of water.**

**Ans:** Plants need a lot of water. Young *Brassica* plants take up an amount of water equal to their shoot weight in about 5 hours. If that applied to us, we would have to drink 3 gallons of water an hour to stay alive.

**22. Which systems perform transport in humans?**

**Ans:** Transport of different materials in human body is performed by two systems.

- Blood circulatory system (Cardiovascular System)
- Lymphatic System

The two systems are well coordinated and associated with each other.

**23. What is a closed circulatory system? (DGK 2014, SGD 2014)**

**Ans: Definition:**

It is a type of circulatory system in which the blood always remains in the blood vessels.

**Examples:**

Humans and other vertebrates.

**24. What is an open circulatory system?**

**Ans: Definition:**

It is a type of circulatory system in which blood does not remain in the blood vessels.

**Example:**

Invertebrates like arthropods.

**25. What are the main components of human blood circulatory system?**

**Ans:** The main components of human blood circulatory system are:

- Blood
- Heart
- Blood vessels

**26. How is plasma separated from blood? Text Book Page # 185  
(LHR 2012, GRW 2014, BWP 2015, SGD 2015)**

**Ans:** Blood is taken from an artery and an anti-coagulant (a chemical that inhibits blood clotting) is mixed in it. After about 5 minutes, plasma separates from blood cells, which settle down.

**27. What do you know about blood?**

**Ans: Blood:**

Blood is a specialized body fluid (a connective tissue) that is composed of a liquid called blood plasma and blood cells. The weight of blood in our body is about  $1/12^{\text{th}}$  of our body. The average adult body has about 5 litres of blood.

**28. Describe composition of plasma.**

**Ans: Composition of Plasma:**

Plasma is primarily water in which proteins, salts, metabolites and wastes are dissolved. Water constitutes about 90-92% of plasma and 8-10% are dissolved substances. Salts make

up 0.9% of plasma, by weight. Proteins make 7-9% by weight of plasma. The important proteins present in plasma are antibodies, fibrinogen, albumin etc. Plasma also contains the digested food, nitrogenous wastes and hormones. Respiratory gases i.e.  $\text{CO}_2$  and  $\text{O}_2$  are present in the plasma.

**29. Tell the number of RBCs in human blood.**

**Text Book Page#186**

**Ans: Males:**

A cubic millimeter of blood contains 5 to 5.5 million of RBCs in males.

**Females:**

A cubic millimeter of blood contains 4 to 4.5 million of RBCs in females.

**30. What are the two different types of WBCs?**

**Ans: Types of WBCs:**

There are two main types of WBCs:

- (i) Granulocytes have granular cytoplasm. These include neutrophils, eosinophils and basophils.
- (ii) Agranulocytes have clear cytoplasm and include monocytes and B and T lymphocytes.

**31. What are Thrombocytes? Describe their function.**

**Text Book Page # 187**

**(LHR 2013)**

**Ans:** They are not cells, but are fragments of large cells of bone marrow, called megakaryocytes. They do not have any nucleus and any pigment.

**Number:**

One cubic millimeter of blood contains 250,000 platelets.

**Lifespan:**

The average life span of a blood platelet is about 7 to 8 days. Platelets help in blood clotting. The clot serves as a temporary seal at the damaged area.

**32. How pus is formed?**

**(SWL 2014)**

**Ans:** White blood cells die in the process of killing the germs. These dead cells accumulate and make the white substance called pus seen at the infection site.

**33. What happens in dengue fever?**

**Ans:** In dengue fever, there is a sharp decrease in the number of platelets in blood. Because of this, patients bleed from the nose, gums and under the skin.

**34. What is leukaemia?**

**Text Book Page # 188**

**Ans:** It is also called as blood cancer. Leukaemia is the production of great number of immature and abnormal white blood cells.

**Causes:**

This is caused by a cancerous mutation (change in gene) in bone marrow or lymph tissue cells. The mutation results in uncontrolled production of defective white blood cells (leukocytes).



35. Write a short note on Thalassaemia.

Text Book Page # 189  
(GRW 2015, SGD 2015)

**Ans:** It is also called Cooley's anaemia on the name of Thomas B. Cooley, an American physician. It is a genetic problem due to mutations in the gene of haemoglobin. The mutation results in the production of defective haemoglobin and the patient cannot transport oxygen properly.

36. What is the incidence of thalassaemia in the world?

**Ans:** There are about 60-80 million people in the world who carry thalassaemia. India, Pakistan, and Iran are seeing a large increase in thalassaemia patients. Pakistan alone has 250,000 such patients. These patients require blood transfusions for life-time.

37. On what date International Thalassaemia day is celebrated? What is its aim?

**Ans:** The world celebrates the International Thalassaemia Day on 8<sup>th</sup> of May. This day is dedicated to raise public awareness about thalassaemia and to highlight the importance of the care for thalassaemia patients.

38. What is an antigen? (LHR 2013, DGK 2014, SGD 2014, RWP 2015)

**Ans:** "A substance which stimulates the production of an antibody when introduced into the body, i.e. it can stimulate an immune response is called an antigen."

39. What is the basis of blood group systems?

**Ans:** Blood group systems are a classification of blood based products on the presence or absence of antigens on the surface of red blood cells.

40. How many human blood groups systems have been studied till to date?

**Ans:** A total of 29 human blood group systems are now recognized by the International Society of Blood Transfusion (ISBT).

41. How many blood groups are there in ABO blood group system?

**Ans:** ABO Blood System:

In this system, there are four different blood groups which are distinct from each other on the basis of specific antigens (antigen A and B) present on the surface of RBCs.

**Blood Group A:**

A person having antigen A has blood group A.

**Blood Group B:**

A person having antigen B has blood group B.

**Blood Group AB:**

A person having both antigens has blood group AB.

**Blood Group O:**

A person having none of the A and B antigens has blood group O.

42. Define blood transfusion.

Text Book Page # 190

**Ans:** "Blood transfusion is the process of transferring blood or blood-based products from one person into the circulatory system of another"

- Blood transfusions can be life-saving in some situations, such as massive blood loss due to injury, or can be used to replace blood lost during surgery.

**43. Why the blood of donor should be checked before transfusion?**

**Ans:** A number of infectious diseases such as AIDS, Hepatitis B and C etc. can pass from the affected donor to the recipient. Before transfusion, the blood of donor is checked for germs etc.

**44. What is universal donor?**

**Text Book Page # 191 (LHR 2014)**

**Ans: Universal Donor:**

O blood group individuals are called universal donors, because they can donate blood to the recipients of every other blood groups.

**45. Draw a checker board for donor and recipient blood groups showing cross matching for blood transfusions.**

**Ans:**

		Recipient Blood Groups			
		A	B	AB	O
Donor Blood Groups	A	✓	×	✓	×
	B	×	✓	✓	×
	AB	×	×	✓	×
	O	✓	✓	✓	✓

**Blood Transfusion: Cross Matching**  
 ✓ : Can be Transfused  
 × : Agglutination

**46. Who discovered Rh blood group system and also discuss its basis of classification.**

**Ans: Discovery:**

In 1930's Karl Landsteiner discovered the Rh-blood group system.

**Types of blood groups:**

In this system, there are two blood groups i.e. Rh-positive and Rh-negative. These blood groups are distinct from each other on the basis of antigens called Rh factors.

**47. Differentiate between pericardium and pericardial fluid. Text Book Page # 192**

**(LHR 2015)**

**Ans:**

PERICARDIUM	PERICARDIAL FLUID
<ul style="list-style-type: none"> <li>• Heart is enclosed in a sac known as pericardium.</li> <li>• It helps in protection of heart muscles.</li> </ul>	<ul style="list-style-type: none"> <li>• Pericardial fluid is a fluid present between pericardium and heart walls.</li> </ul>

- |  |   |
|--|---|
|  | <ul style="list-style-type: none"> <li>• It reduces friction between pericardium and heart, during heart contractions.</li> </ul> |
|--|---|

**48. Why heart is felt to be present on left side of our body?**

**Ans:** The heart is usually felt to be on the left side because the left chamber of the heart i.e. left ventricle is stronger and has a thicker wall. It pumps blood to all body parts.

**49. What is the mass and size of heart in normal adults?**

**Ans:** In normal adults, the mass of the heart is about 250-350 grams, and its size is equal to a clenched fist.

**50. How can we say that heart works as double pump?**

**Ans:** Human heart works as a double pump. It receives deoxygenated (with less oxygen) blood from body and pumps it to lungs. At the same time, it receives oxygenated (with more oxygen) blood from lungs and pumps it to all body. Inside heart chambers, the deoxygenated and oxygenated bloods are kept separated.

**51. Why the walls of the left ventricle are the thickest one?**

**Ans:** The walls of the left ventricle are the thickest one. These are about a half inch thick. They have enough force to push blood into the body. This gives an evidence that the structures of the parts of heart are adaptive to their function.

**52. Name and explain the valves present in heart.**

**Ans: Valves:**

- The opening between right atrium and right ventricle is guarded by a valve known as tricuspid valve (because it has 3 flaps).
- At the base of pulmonary trunk, pulmonary semilunar valve is present in which prevents the backflow of blood from pulmonary trunk to right ventricle.
- The opening between left atrium and left ventricle is guarded by a valve known as bicuspid valve (because it has two flaps).
- Aortic semilunar valves

**53. Define pulmonary circulation. (BWP 2014, 2015, SWL 2015)**

**Ans:** The pathway on which deoxygenated blood is carried from heart to lungs and in return oxygenated blood is carried from lungs to heart is called pulmonary circulation or circuit.

**54. What is systemic circulation? (LHR 2014, 2016)**

**Ans: Systemic Circulation:**

“The pathway on which oxygenated blood is carried from heart to body tissues and in return deoxygenated blood is carried from body tissues to heart is called systemic circulation or circuit”.

**55. Justify that there is low blood pressure in pulmonary circulation.**

**Ans:** The blood in pulmonary circulation is at lower pressure than the blood in systemic circulation. It gives sufficient time to blood for gaseous exchange in lungs.

**56. What is meant by cardiac cycle? / Define heartbeat. Text Book Page # 194**

**(GRW 2012, 2015, LIIR 2014)**

**Ans:** "The relaxation of heart chambers fills them with blood and contractions of chambers propels blood out of them. The alternating relaxation and contractions make up the cardiac cycle and one complete cardiac cycle makes one heartbeat".

**Duration:**

The total duration of cardiac cycle is 0.8 seconds.

**57. Define cardiac diastole.**

**(GRW 2013, BWP 2015)**

**Ans: Cardiac diastole:**

"Atria and ventricles relax and blood is filled in atria. This period is called cardiac diastole."

**Duration:**

The duration of cardiac diastole is 0.4 seconds.

**58. Define systole and diastole. / What is difference between systole and diastole?**

**(LHR 2016, MTN 2015, FSD 2014, SGD 2014)**

**Ans: Systole:**

"The period of atrial and ventricular contraction is called systole."

**Diastole:**

When Atria and ventricles relax blood is filled in atria. This period is called diastole.

**59. How the sound of lubb dubb is produced during heart beat? (LHR 2016)**

**Ans:** When ventricles contract, tricuspid and bicuspid valves close and "lubb" sound is produced. Similarly when ventricles relax, the semilunar valves close and "dubb" sound is produced. "Lubb-dubb" can be heard with the help of a stethoscope.

**60. What is the average human heartbeat?**

**Ans:** The average human heart beats 70 times/minute. So it would beat approximately 2.5 billion times during a life time of 66 years.

**61. Define pulse.**

**Ans:** "Pulse is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of heart".

**Pulse Points:**

Pulse can be felt at areas where artery is close to skin for example at wrist, neck, groin, or top of foot. Most commonly, people measure their pulse in their wrist.

**62. Write any two differences between arteries and veins. (LHR 2016, SGD 2015)**

**Ans:**

ARTERIES	VEINS
<ul style="list-style-type: none"> <li>• Carry blood away from heart.</li> <li>• Thick and elastic.</li> </ul>	<ul style="list-style-type: none"> <li>• Carry blood towards heart.</li> <li>• Thin and less elastic.</li> </ul>

**63. What is vascular surgery?**

**Text Book Page#198**

**Ans: Definition:**

The field in surgery in which diseases of arteries and veins are managed by surgical methods is called vascular surgery.

**Example:** Thrombosis

**Vascular Surgeon:**

A vascular surgeon treats diseases of all parts of blood circulatory system except that of heart and brain.

**64. What is the contribution of Ibn-e-Nafees in the study of human blood circulatory system? (BWP 2015)**

**Ans: Period:**

1210-1286 AD

**Specialty:**

He was a physician.

**Contribution:**

He is honored to be the first scientist who described the path way of blood circulation.

**65. What is the contribution of William Harvey in the study of human blood circulatory system? Text Book Page#200**

**Ans: Period:**

1578-1657 AD

**Contribution:**

He discovered the pumping action of heart and the pathway of blood in major arteries and veins.

**66. How heart muscles are supplied with blood?**

**Ans:** Even though the heart chambers are continually bathed with blood, this does not nourish heart muscles. The blood supply to heart muscles is provided by coronary arteries, which emerge from the base of aorta. Heart muscles are drained by coronary veins, which empty into right atrium. Coronary arteries and veins are collectively called coronary circulation and it is a part of systemic circulation.

**67. Write causes of cardiovascular disorders. Text Book Page#202 (LHR 2015)**

**Ans: Causes of Cardiovascular disorders:**

The causes that lead to cardiovascular disorders include:

- Advanced age
- Diabetes
- High blood concentration of low density lipids (e.g. cholesterol)
- Tobacco smoking
- High blood pressure

- Obesity
- Sedentary lifestyle

**68. What is difference between atherosclerosis and arteriosclerosis?**

**Ans:**

<b>ATHEROSCLEROSIS</b>	<b>ARTERIOSCLEROSIS</b>
<ul style="list-style-type: none"> <li>• It is commonly referred to as a "narrowing" of arteries.</li> <li>• It is a chronic disease in which there is accumulation of fatty materials, cholesterol, or fibrin in arteries.</li> </ul>	<ul style="list-style-type: none"> <li>• It is a general term describing any hardening of arteries.</li> <li>• It occurs when calcium is deposited in the walls of arteries.</li> </ul>

**69. What is a silent heart attack?**

**Text Book Page#203**

**Ans:** Approximately one fourth of all myocardial infarctions are silent i.e. without chest pain or other symptoms. A silent heart attack is more common in the elderly, in patients with diabetes mellitus and after heart transplantation.

**70. Define myocardial infarction.**

**(LHR 2015, SWL 2014, FSD 2015)**

**Ans:** The term myocardial infarction is derived from myocardium (the heart muscle) and infarction (tissue death). It is more commonly known as a heart attack. It occurs when blood supply to a part of heart is interrupted and leads the death of heart muscles.

**71. What is Angioplasty and bypass surgery?**

**Text Book Page#204 (LHR 2013)**

**Ans: Angioplasty:**

Angioplasty is a mechanical widening of a narrowed or totally obstructed blood vessels.

**Bypass Surgery:**

Surgery in which arteries or veins from elsewhere in the patient's body are grafted to the coronary arteries to improve blood supply to heart muscles.

**72. What is angina pectoris?**

**(GRW 2014)**

**Ans: Angina Pectoris:**

Angina pectoris means "chest pain". It is not as severe as heart attack. The pain may occur in heart and often in left arm and shoulder. It is a warning sign that blood supply to heart muscles is not sufficient but shortage is not enough to cause tissue death.

**73. What percentage of our population is diabetic?**

**Ans:** About 10% of our population is diabetic.

**74. What is the ratio of obese population in Pakistan?**

**Ans:** According to World Health Organization, in Pakistan, 1 in 7 urban adults is obese.

**75. What is the percentage of adult deaths by cardiovascular disorders in Pakistan?**

**Ans:** According to the survey of Federal Bureau of Statistics of Pakistan, cardiovascular disorders were reported as the cause of 12% of the adult deaths in Pakistan.

**76. What is the most common cause of cardiovascular disorders in Pakistan?**

**Ans:** The most common cause of cardiovascular disorders in Pakistan is hypertension (blood pressure higher than normal)

- There are over 12 million hypertensive patients in Pakistan.

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## Unit 9: Transport

### Multiple Choice Questions

- The outermost layer of the root: Text Book Page#172  
 (a) Endodermis (b) Cortex  
 (c) Pericycle (d) Epidermis
- Roughly how much of water that enters a plant is lost via transpiration? Text Book Page#173  
 (a) 50% (b) 70%  
 (c) 80% (d) 90%
- Transpiration from plant surface takes place through: (MTN 2015)  
 (a) Cuticle (b) Stomata  
 (c) Lenticels (d) All of these
- The roots and root hairs absorb water from soil by: (RWL 2015)  
 (a) Osmosis (b) Diffusion  
 (c) Phloem (d) Filtration
- The rate of transpiration doubles with every rise of temperature. Text Book Page#175  
 (a) 10°C (b) 20°C  
 (c) 30°C (d) 40°C
- The temperature range at which transpiration stops: (FSD 2015)  
 (a) 40°C-45°C (b) 10°C-20°C  
 (c) 20°C-40°C (d) 20°C-45°C
- Transpiration rate depends upon: (GWL 2014)  
 (a) Leaf surface area (b) Water content  
 (c) Temperature (d) All of these
- In humid, air the rate of transpiration is: Text Book Page#183  
 (a) High (b) Low  
 (c) Normal (d) None of these
- In most plants, food is transported in the form of: (GRW 2015, DGK 2014)  
 (a) Glucose (b) Sucrose  
 (c) Lactose (d) Maltose
- Which part of plant is responsible for transporting food? (FSD 2014)  
 (a) Xylem (b) Phloem  
 (c) Root (d) Leaf
- According to the pressure-flow mechanism, the actual force behind the movement of food in phloem: Text Book Page#184  
 (a) Drop in the pressure at the sink end. (b) Rise in the pressure at the sink end.  
 (c) Drop in the pressure at the source end. (d) Rise in the pressure at the source end.
- The average volume of blood in adult human's body is: Text Book Page#185  
(SWL 2014)  
 (a) 5 litres (b) 7 litres  
 (c) 8 litres (d) 10 litres
- Percentage of plasma in blood:  
 (a) 35% (b) 45%  
 (c) 55% (d) 65%
- Percentage of cells or cell like bodies in blood:  
 (a) 35% (b) 45%

- (c) 55% (d) 65%
15. Percentage of water in plasma:  
(a) 60-62% (b) 70-72%  
(c) 80-82% (d) 90-92%
16. Blood clotting protein:  
(a) Fibrinogen (b) Pepsin  
(c) Pepsinogen (d) Albumin
17. When fibrinogen makes blood clot it separates from blood and the remainder is called: (LHR 2015)  
(a) Lymph (b) Plasma  
(c) Serum (d) Pus
18. The normal PH of Human blood is: (LHR 2016)  
(a) 7.2 (b) 7.3  
(c) 7.4 (d) 7.5
19. Average Number of red blood cells in a cubic millimeter of blood: Text Book Page#186  
(a) 4.5 (b) 5  
(c) 5.5 (d) All of these
20. In the embryonic and faetal life, red blood cells are formed in: (LHR 2013)  
(a) Liver (b) Spleen  
(c) Bone marrow (d) Both (a) and (b)
21. Average life span of erythrocytes:  
(a) 100 days (b) 110 days  
(c) 120 days (d) 130 days
22. Which cell play role in body's defence? (SGD 2015)  
(a) Erythrocytes (b) Thrombocytes  
(c) Basophils (d) Leukocytes
23. The average number of leukocytes in one cubic millimeter of blood:  
(a) 3000 to 40000 (b) 5000 to 6000  
(c) 7000 to 8000 (d) 9000 to 10000
24. The blood cells which do not contain pigments and are colourless:  
(a) Red Blood cells (b) White Blood Cells  
(c) Platelets (d) All of these
25. Which one is an agranulocyte?  
(a) Monocyte (b) Basophil  
(c) Neutrophil (d) Eosinophil
26. Which of the following prevents blood clotting?  
(a) Neutrophils (b) Eosinophils  
(c) Monocytes (d) Basophils
27. The blood cells which help in blood clotting: Text Book Page#187 (SWL 2014)  
(a) Red blood cells (b) White blood cells  
(c) Platelets (d) B and T lymphocytes
28. Number of thrombocytes (Platelets) in one cubic millimeter of blood is: (BWL 2014)  
(a) 150,000 (b) 250,000  
(c) 350,000 (d) 450,000
29. Average life span of platelets:  
(a) 4 to 5 days (b) 5 to 6 days  
(c) 6 to 7 days (d) 7 to 8 days
30. Which blood cells are the most numerous in healthy human blood? (MTN 2015)  
(a) Red Blood cells (b) White Blood Cells  
(c) Platelets (d) All of these

31. Uncontrolled production of defective white blood cells: **Text Book Page#188**  
 (a) Thalassaemia (b) Leukaemia  
 (c) Anaemia (d) Both (a) & (b)
32. Which of the following is a genetic problem due to mutations in the gene of haemoglobin? **Text Book Page#189**  
 (a) Thalassaemia (b) Leukaemia  
 (c) Anaemia (d) Both (a) and (b)
33. The world celebrates the International Thalassaemia Day on:  
 (a) 6<sup>th</sup> of May (b) 7<sup>th</sup> of May  
 (c) 8<sup>th</sup> of May (d) 9<sup>th</sup> of May
34. Total number of blood group systems recognized by the International Society of Blood Transfusion:  
 (a) 25 (b) 27  
 (c) 29 (d) 31
35. A molecule that can stimulate an immune response:  
 (a) Antigen (b) Anti body  
 (c) haemoglobin (d) All of these
36. ABO blood group system was discovered by:  
 (a) Thomas B. Cooley (b) William Harvey  
 (c) Karl Landsteiner (d) Ibn-e-Nafees
37. Antigens are present on the surface of:  
 (a) Red Blood cells (b) White Blood Cells  
 (c) Platelets (d) All of these
38. Which blood Group contains Antigen A? **Text Book Page#190 (BWL 2015)**  
 (a) A (b) B  
 (c) AB (d) O
39. In persons with blood group O:  
 (a) Anti bodies A&B are present  
 (b) Neither antigen A nor antigen B is present  
 (c) Only Antigen A is present  
 (d) Both (a) & (b)
40. A person having blood group B can donate blood to: **Text Book Page#191**  
 (a) O and A (b) O and AB  
 (c) B and AB (d) A and B
41. A person with AB blood group can donate to: **(SWL 2015)**  
 (a) A (b) B  
 (c) AB (d) O
42. A person having blood group O can receive blood from:  
 (a) A (b) B  
 (c) AB (d) O
43. Universal blood donors. **(DGK 2015, LHR 2016)**  
 (a) Blood Group A (b) Blood Group B  
 (c) Blood Group AB (d) Blood Group O
44. Universal blood recipients: **(SGD 2016)**  
 (a) Blood Group A (b) Blood Group B  
 (c) Blood Group AB (d) Blood Group O
45. Karl Landsteiner discovered the Rh-blood group system in:  
 (a) 1910 (b) 1920  
 (c) 1930 (d) 1940
46. What is the actual universal donor blood group? **Text Book Page#192**  
 (a) O- Negative (b) O positive  
 (c) AB-positive (d) AB-Negative

47. Which organ belongs to circulatory system? (GRW 2013)  
 (a) Eye (b) Kidney  
 (c) Heart (d) Stomach
48. The largest and strongest chamber in heart is: (LHR 2016)  
 (a) Right atrium (b) Left atrium  
 (c) Left ventricle (d) Right ventricle
49. The opening between right atrium and right ventricle is guarded by a valve called:  
 (a) Bicuspid valve (b) Tricuspid valve  
 (c) Pulmonary semilunar valve (d) Aortic semilunar valve
50. The type of valve present at the base of pulmonary trunk:  
 (a) Bicuspid valve (b) Tricuspid valve  
 (c) Pulmonary semilunar valve (d) Aortic semilunar valve
51. The opening between left atrium and left ventricle is guarded by a valve called:  
 Text Book Page#193  
 (a) Bicuspid valve (b) Tricuspid valve  
 (c) Pulmonary semilunar valve (d) Aortic semilunar valve
52. The alternating contraction and relaxation of heart chambers: Text Book Page#194  
 (a) Systole (b) Diastole  
 (c) Cardiac cycle (d) Pulse rate
53. Average human heart beat per minute:  
 (a) 60 (b) 70  
 (c) 80 (d) 90
54. During atrial systole:  
 (a) Both atria contract (b) Both atria relax  
 (c) Both ventricles contract (d) Both ventricles relax
55. In one heart beat, diastole remains about second: Text Book Page#195 (LHR 2014)  
 (a) 0.4 (b) 0.6  
 (c) 0.7 (d) 0.8
56. "Lubb-dubb" can be heard with the help of: (LHR 2014)  
 (a) Stethoscope (b) Telescope  
 (c) Microscope (d) Sound box
57. In normal adults, the mass of heart is: (LHR 2015, 2016)  
 (a) 50 – 150g (b) 150 – 250g  
 (c) 250 – 350g (d) 350 – 450g
58. When does our heart takes rest? Text Book Page#196 (GRW 2014)  
 (a) During sleep (b) During rest  
 (c) During working (d) Never
59. The third part of blood circulatory system: Text Book Page#197  
 (a) Heart (b) Blood  
 (c) Blood vessels (d) Capillaries
60. The blood vessels that carry blood away from heart: (SWL 2015)  
 (a) Arteries (b) Veins  
 (c) Capillaries (d) All of these
61. The tissue layer that is common in all types of blood vessels:  
 (a) Connective tissue (b) Elastic tissue  
 (c) Endothelium (d) Smooth muscles
62. In which of the following blood vessels, the blood pressure is low?  
 Text Book Page#199  
 (a) Arteries (b) Capillaries  
 (c) Veins (d) All of these
63. The blood pressure in arteries is:  
 (a) High (b) Medium

- (c) Low (d) Very low
64. Which of the following blood vessels have valves to prevent back flow of blood?  
 (a) Arteries (b) Capillaries  
 (c) Veins (d) All of these
65. Through which blood vessels the materials are exchanged between the blood and the surrounding tissues?  
 (a) Arteries (b) veins  
 (c) Capillaries (d) All of these  
 Text Book Page#200 (GWL 2013)
66. These are smallest blood vessels:  
 (a) Arteries (b) Capillaries  
 (c) Veins (d) Lymph vessels  
 (SGD 2015)
67. Who discovered the pathway of blood circulation?  
 (a) Ibn-e-Nafees (b) William Harvey  
 (c) Karl Landsteiner (d) All of these
68. William Harvey was born in:  
 (a) 1560AD (b) 1578AD  
 (c) 1590AD (d) 1592AD
69. William Harvey died in:  
 (a) 1647AD (b) 1653AD  
 (c) 1657AD (d) 1663AD
70. The pumping action of heart was discovered by:  
 (a) Ibn-e-Nafees (b) William Harvey  
 (c) Karl Landsteiner (d) None of these
71. As aorta passes down through thorax, it becomes:  
 (a) Aorta (b) Aortic arch  
 (c) Dorsal aorta (d) All of these
72. Intercostal arteries supply blood to:  
 (a) Digestive tract (b) Kidneys  
 (c) Liver (d) Ribs
73. Caeliac artery and superior mesenteric artery supply blood to:  
 (a) Digestive tract (b) Kidneys  
 (c) Liver (d) Ribs
74. Hepatic artery supplies blood to:  
 (a) Digestive tract (b) Kidneys  
 (c) Liver (d) Ribs
75. Renal arteries supply blood to:  
 (a) Digestive tract (b) Kidneys  
 (c) Liver (d) Ribs  
 Text Book Page#201
76. Gonadal arteries supply blood to:  
 (a) Digestive tract (b) Kidneys  
 (c) Liver (d) Gonads
77. Each external iliac becomes femoral artery in upper thigh and gives branches to:  
 (a) Thigh and Knee (b) Shank  
 (c) Ankle and foot (d) All of these
78. Different veins from head, shoulders, and arms joined together and form:  
 (a) Inferior vena cava (b) Superior vena cava  
 (c) Hepatic portal vein (d) Femoral vein  
 Text Book Page#202
79. Right and left common iliac veins join to form:  
 (a) Inferior vena cava (b) Superior vena cava  
 (c) Hepatic portal vein (d) Femoral vein

80. All veins coming from stomach, spleen, Pancreas and Intestine drain into:  
 (a) Renal vein (b) Hepatic vein  
 (c) Hepatic portal vein (d) Common iliac vein
81. Atherosclerosis is commonly referred to as a:  
 (a) Widening of arteries (b) Narrowing of arteries  
 (c) Hardening of arteries (d) All of these
82. If a thrombus dislodges and becomes free floating, it is called: Text Book Page#203  
 (a) Plaques (b) Stone  
 (c) Embolus (d) All of these
83. Arteriosclerosis is a general term describing:  
 (a) Widening of arteries (b) Narrowing of arteries  
 (c) Hardening of arteries (d) All of these
84. Heart attack may be caused by blood clot in:  
 (a) Heart Muscles (b) Heart Chambers  
 (c) Coronary arteries (d) Veins
85. The most common symptom of myocardial infarction is:  
 (a) Pain in left arm (b) Pain in neck  
 (c) Pain in right arm (d) Severe Chest pain
86. Angina pectoris means: Text Book Page#204  
 (a) Chest Pain (b) Tissue death  
 (c) Heart Attack (d) Silent death
87. World heart Day is held on: (RWL 2015)  
 (a) 28<sup>th</sup> August (b) 28<sup>th</sup> September  
 (c) 28<sup>th</sup> October (d) 28<sup>th</sup> November

### ANSWERS KEY

1	d	11	a	21	c	31	b	41	c	51	a	61	c	71	c	81	b
2	d	12	a	22	d	32	a	42	d	52	c	62	c	72	d	82	c
3	d	13	c	23	c	33	c	43	d	53	a	63	a	73	a	83	c
4	B	14	b	24	b	34	c	44	c	54	a	64	c	74	c	84	c
5	A	15	d	25	a	35	a	45	c	55	a	65	c	75	b	85	d
6	A	16	a	26	d	36	c	46	a	56	a	66	b	76	d	86	a
7	D	17	c	27	c	37	a	47	c	57	c	67	b	77	d	87	b
8	B	18	c	28	b	38	a	48	c	58	d	68	b	78	b		
9	b	19	b	29	d	39	a	49	b	59	c	69	c	79	a		
10	b	20	d	30	a	40	c	50	c	60	a	70	b	80	c		

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## Unit 9: Transport

### Long Questions

**Q.1** How water and other ions are taken up from roots to other parts of plant? Explain.

Text Book Page # 172

**Ans:** **WATER & ION UPTAKE**

#### Functions of Roots:

In addition to anchor the plant, roots perform two other vital functions. These are:

- They absorb water and salts from soil.
- They provide conducting tissues for distributing these substances to the tissues of stem.

#### INTERNAL STRUCTURE OF ROOT

**1. Vascular Tissues:**

The conducting tissues (xylem and phloem) of the root are grouped in the centre to form a rod-shaped core. This rod extends throughout the length of the root.

**2. Pericycle:**

Outside the conducting tissues, there is a narrow layer of thin-walled cells, the pericycle.

**3. Endodermis:**

A single layer of cells called endodermis surrounds the pericycle.

**4. Cortex:**

External to endodermis, there is a broad zone of cortex. It consists of large and thin-walled cells.

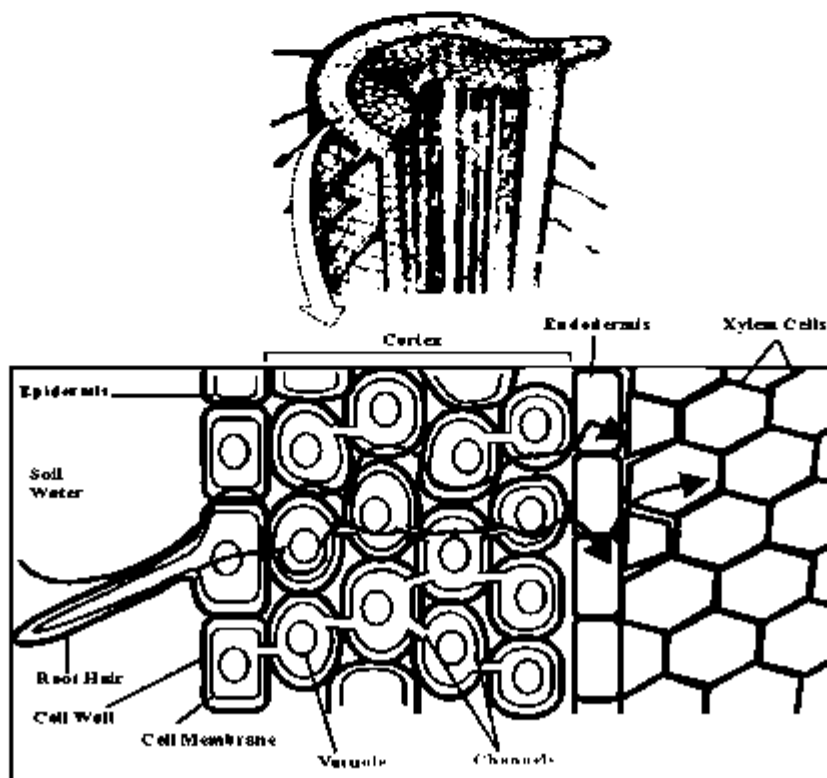


Figure: Uptake of Water and Ions by Root



**5. Epidermis:**

The cortex is bounded on outside by a single layer of epidermal cells.

**6. Root Hairs:**

Roots have clusters of tiny root hairs. These are actually the extensions of epidermal cells.

**Function:**

Root hairs provide a large surface area for absorption. They grow out into the spaces between soil particles where they are in direct contact with water.

**MECHANISM OF TRANSPORTATION**

**Movement of Water into Root Hairs:**

The cytoplasm of root hairs has higher concentration of salts than the soil water, so water moves by osmosis into the root hairs.

**Movement of Salts into Root Hairs:**

Salts enter root hairs by diffusion or active transport.

**Entry into Xylem Tissues:**

After their entry into the root hairs, water and salts travel through intercellular spaces or through cells (via channels, called plasmodesmata) and reach xylem tissue. Once in xylem, water and salts are carried to all the aerial parts of plant.

**Q.2 Write a note on transpiration.**

**Text Book Page # 173 (LHR 2012)**

**Ans:**

**TRANSPIRATION**

**Definition:**

The loss of water from plant surface through evaporation is called transpiration.

**Types of Transpiration:**

There are three types of transpiration. This loss may occur through stomata in leaves, through the cuticle present on leaf epidermis, and through special openings called lenticels present in stems of some plants.

**1. Stomatal Transpiration:**

Most of the transpiration occurs through stomata of the leaves and is called stomatal transpiration.

**Mechanism**

- The mesophyll cells of leaf provide large surface area for the evaporation of water.
- Water is drawn from xylem into mesophyll cells, from where it comes out and makes a water film on the cell walls of mesophyll cell.
- From here, water evaporates into air spaces of the leaf.
- Water vapours then diffuse from air spaces towards the stomata and then pass to outside air.

**2. Cuticular Transpiration:**

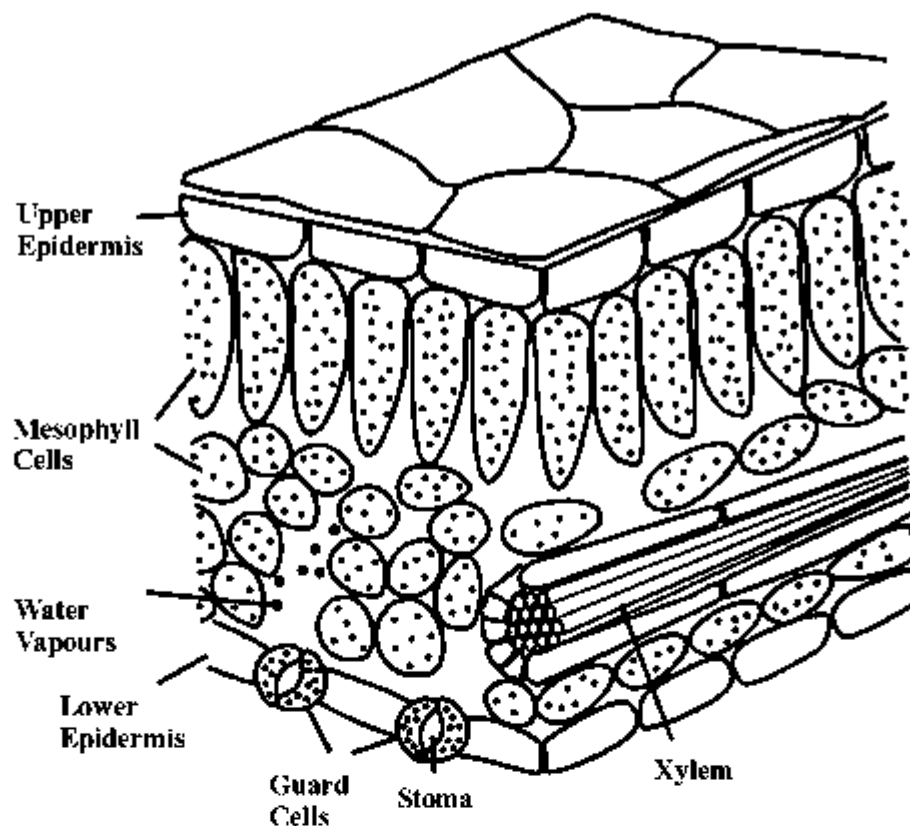
The transpiration which is through the cuticle present on the leaf epidermis

**3. Lenticular Transpiration:**

The transpiration which is through special openings called lenticels present on the stems of some plants.

**Quantity of Transpired Water:**

Roughly 90% of the water that enters a plant is lost via transpiration.



**Figure: Events of Transpiration shown in the Section of a Leaf**

**Q.3** Describe the mechanism of opening and closing of stomata. Text Book Page # 174  
(LHR 2016)

**Ans:** **OPENING AND CLOSING OF STOMATA**

Most plants keep their stomata open during the day and close them at night. It is the responsibility of stomata to regulate transpiration via the actions of guard cells.

**Structure of Stomata:**

The two guard cells of a stoma are attached to each other at their ends. The inner concave sides of guard cells that enclose a stoma are thicker than the outer convex sides.

**Function:**

Stomata regulate transpiration by the action of guard cells.

**Opening of Stomata:**

When the guard cells get water and become turgid, their shapes are like two beans and the stoma between them opens.

**Closing of Stomata:**

When guard cells lose water and become flaccid, their inner sides touch each other and the stoma closes.

**Role of Glucose:**

The concentration of solutes (glucose) in guard cells is responsible for the opening and closing of stomata.

#### **Role of Potassium Ions:**

Recent studies have revealed that light causes the movement of potassium ions from epidermal cells into guard cells.

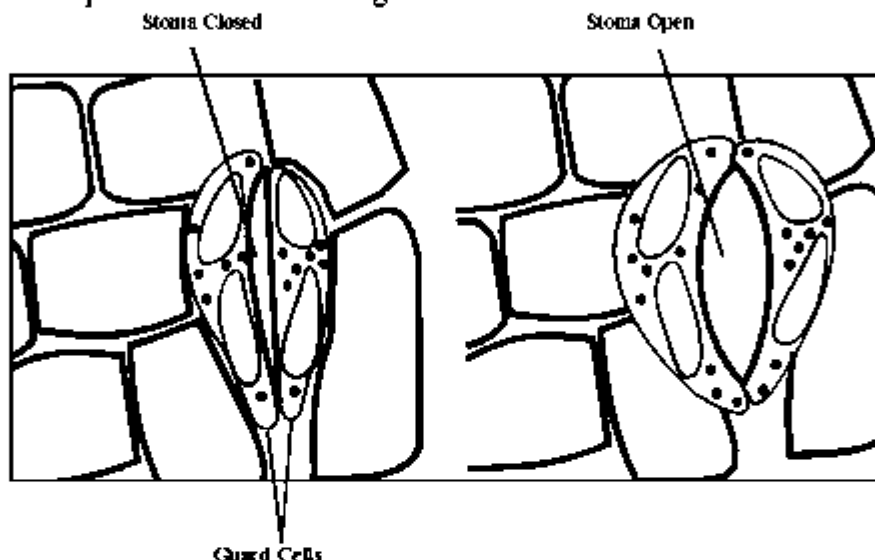
#### **During Daylight:**

Light causes the movement of potassium ions from epidermal cells into guard cells. Water follows these ions and enters guard cells. Thus their turgidity increases and stoma opens. As the day progresses guard cells make glucose and become hypertonic. So water stays in them.

#### **At Night:**

At the end of the day, potassium ions flow back from guard cells to the epidermal cells and the concentration of glucose also falls. Due to it, water moves to epidermal cells and guard cells lose turgor. It causes closure of stomata.

Some plants open their stomata at night when the overall water stress is low.



**Figure: Opening and Closing of Stoma**

**Q.4 Describe the factors affecting the rate of transpiration. Text Book Page # 175**

**(GRW 2012, 2014, 2015, LIIR 2013, 2014, FSD 2014, SGD 2014, DGK 2015)**

**Ans: FACTORS AFFECTING RATE OF TRANSPIRATION**

The factors which affect the rate of transpiration are as follows:

**1. Light:**

The rate of transpiration is directly controlled by the opening and closing of stomata and it is under the influence of light. In strong light the rate of transpiration is very high as compared to dim or no light.

**2. Temperature:**

High temperature reduces the humidity of the surrounding air and also increases the kinetic energy of water molecules. In this way it increases the rate of transpiration. The rate of transpiration doubles with every 10 °C rise in temperature.

Very high temperature i.e. 40-45 °C causes closure of stomata, so transpiration stops and the plant does not lose much needed water.

**3. Humidity:**

When air is dry, water vapours diffuse more quickly from the surface of mesophyll cells into leaf air spaces and then from air spaces to outside. This increases in the rate of transpiration. In humid air, the rate of diffusion of water vapours is reduced and the rate of transpiration is low.

**4. Wind:**

Wind (air in motion) carries the evaporated water from leaves and it causes an increase in the rate of evaporation from the surfaces of mesophyll. When air is still, the rate of transpiration is reduced.

**5. Leaf Surface Area:**

The rate of transpiration also depends upon the surface area of the leaf. More surface area provides more stomata and there is more transpiration.

**Q.5 Describe the significance of transpiration.**

**Text Book Page # 176  
(SGD 2015, RWP 2015)**

**Ans:**

**SIGNIFICANCE OF TRANSPIRATION**

**Necessary Evil:**

Transpiration is called a necessary evil. It means that transpiration is a potentially harmful process but is unavoidable too.

**Disadvantages:**

Transpiration may be a harmful process in the sense that during the conditions of drought, loss of water from plant results in:

- Serious desiccation
- Wilting
- Often death

**Advantages:**

On the other hand, transpiration is necessary too in the following ways:

**Transpirational Pull:**

It creates a pulling force called transpirational pull, which is principally responsible for the conduction of water and salts from roots to the aerial parts of plant body.

**Cooling Effect:**

When water transpires from the surfaces of plant, it leaves a cooling effect on plant. This is especially important in warmer environments.

**Gaseous Exchange:**

The wet surfaces of leaf cells allow gaseous exchange.

**Q.6 Describe transport of water in plants.**

**Text Book Page # 181  
(LHR 2014, DGK 2015)**

**Ans:**

**TRANSPORT OF WATER**

**Introduction:**

The process by which water is raised to considerable heights in plants has been studied for years in botany. The result of this research is "Cohesion-Tension Theory".

### COHESION-TENSION THEORY

#### **Statement:**

According to this theory, the force which carries water (and dissolved materials) upward through the xylem is transpirational pull. Transpiration creates a pressure difference that pulls water and salts up from roots.

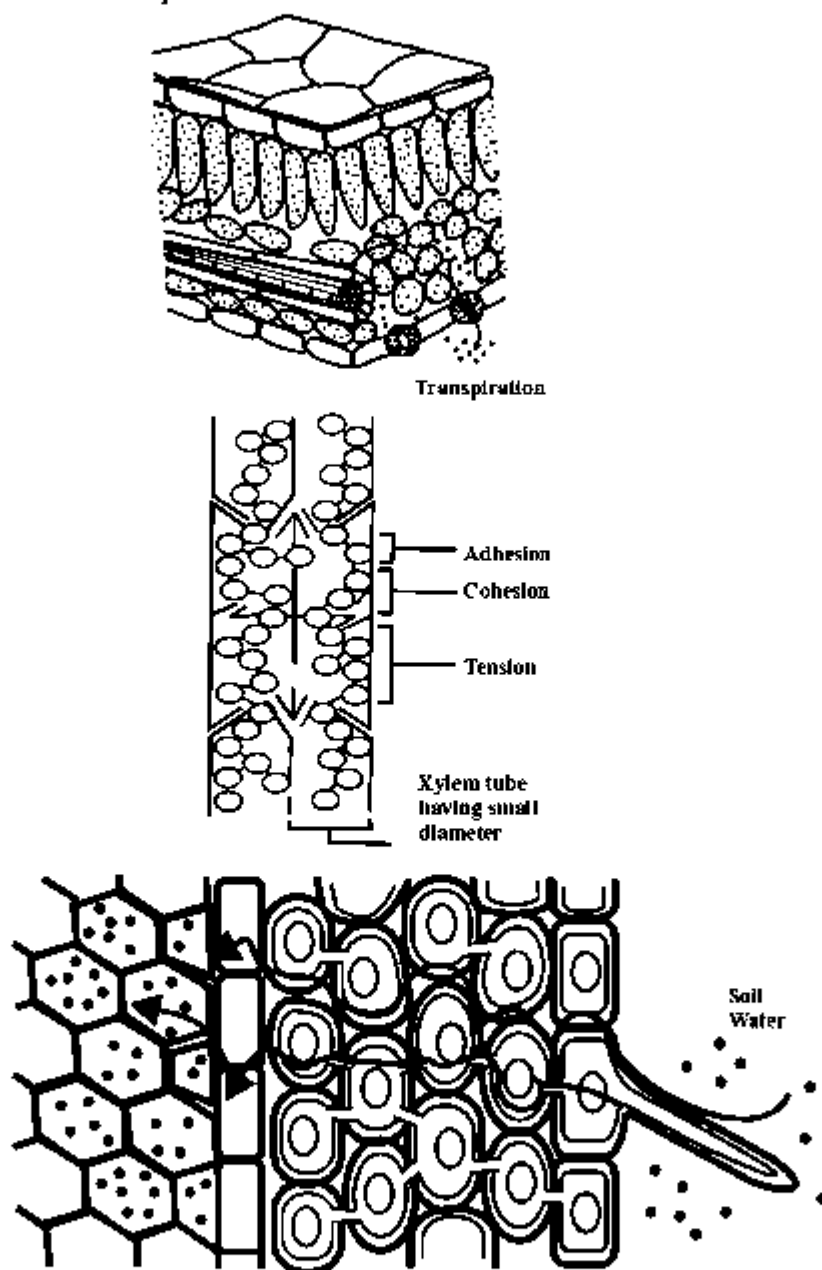


Figure: Transport of Water

#### **Explanation:**

When a leaf transpires (loses water), the water concentration of its mesophyll cells drops. This drop causes water to move by osmosis from the xylem of leaf into mesophyll cells. When one water molecule moves up in the xylem tissue of leaf, it creates a pulling force that continues all the way to the root. This pulling force created by the transpiration of water is called transpirational pull. It also causes water to move transversely, from root epidermis to cortex and pericycle.

### **Reasons of Transpiration Pull:**

Following are the reasons for the creation of transpiration pull:

**1. Xylem Diameter:**

Water held in a tube (xylem) has a small diameter.

**2. Adhesion:**

Water molecules adhere to the walls of xylem tube, this phenomenon is called adhesion.

**3. Cohesion:**

Water molecules cohere to each other, this phenomenon is called cohesion.

### **Formation of Water Column:**

These attractions make an over all tension among water molecules. This tension forms columns of water. The columns of water move from root to shoot and the water content of the soil enters in these columns.

### **One way street:**

Xylem is a one way street from the root to the leaves for water and salts.

**Q.7 Describe transport of food in plants.**

**Text Book Page # 183**

**(GRW 2012, FSD 2015)**

**Ans:**

### **TRANSPORT OF FOOD**

#### **Phloem:**

Phloem is responsible for transporting food substance throughout plant body.

The glucose formed during photosynthesis in mesophyll cells, is used in respiration and the excess of it is converted into sucrose. In most plants, the food is transported in the form of sucrose.

### **PRESSURE-FLOW MECHANISM**

The movement of food in plants has been studied for years. The currently accepted hypothesis states that transport of food is through pressure-flow mechanism.

#### **Statement:**

In pressure-flow mechanism, the food is moved from sources to sinks.

#### **Sources:**

Sources include the exporting organs, typically:

- A mature leaf
- A storage organ

#### **Sinks:**

Sinks are areas of active metabolism or storage, such as:

- Roots
- Tubers
- Developing fruits and leaves
- Growing regions

#### **Storage Organ:**

A storage organ is capable of storing food and exporting the stored materials.

#### **Example:**

The root of beet is a sink in first growing season, but becomes source in the next growing season, when sugars are utilized in the growth of new shoots.

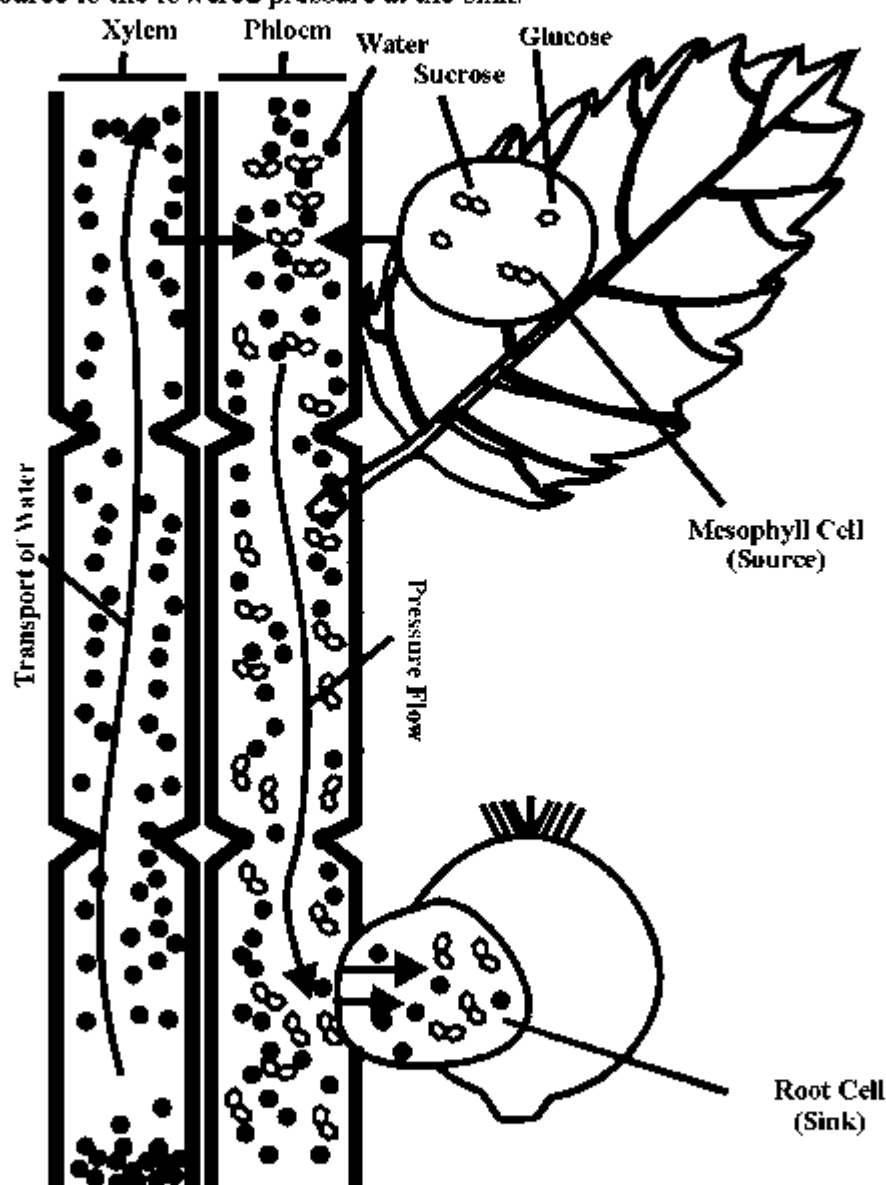
**Explanation:**

**At the source end:**

At source, food (sugars) is moved by active transport into the sieve tubes of phloem. Due to the presence of sugar in sieve-tubes, their solute concentration increases and water enters them from xylem via osmosis. This results in a higher pressure of water in these tubes, which drives the solution of food towards sink.

**At the sink end:**

The food is unloaded by active transport. Water also exits from the sieve tubes. The exit of water decreases pressure in sieve tubes, which causes a mass flow from the higher pressure at the source to the lowered pressure at the sink.



**Figure: Transport of Food**

**Direction of Transport:**

Xylem is a one way street from roots to leaves for water and salts. Phloem is a two way street for food. The direction of the movement of food is decided by demand and supply in sinks and sources.

**Q.8 Write a note on blood.**

**Text Book Page # 185 (SWL 2015)**

**Ans:**

**BLOOD**

Blood is a specialized body fluid (a connective tissue) that is composed of:

- A liquid called Blood Plasma
- Blood Cells

**Weight:**

The weight of blood in our body is about  $1/12^{\text{th}}$  of our body.

**Volume:**

The average adult body has about five liters of blood.



**Figure: Percentage Composition of Human Blood**

**BLOOD PLASMA**

**(GRW 2013, SWL 2014)**

Plasma is mainly water in which the following are dissolved:

- Proteins
- Salts
- Ions
- Metabolites
- Wastes

**Percentage Composition:**

- Water constitutes about 90-92% of plasma.
- Dissolved substances constitute about 8-10% of plasma.

**Salts:**

Salts make up 0.9% of the plasma by weight. Sodium chloride (the table salt) and salts of bicarbonate are present in considerable amount.

**Trace Elements:**

The following trace elements are also found:

- Ca
- Mg
- Cu
- K
- Zn

**pH:**



Changes in the concentration of any salt can change the pH of blood. Normal pH of blood is 7.4.

**Proteins:**

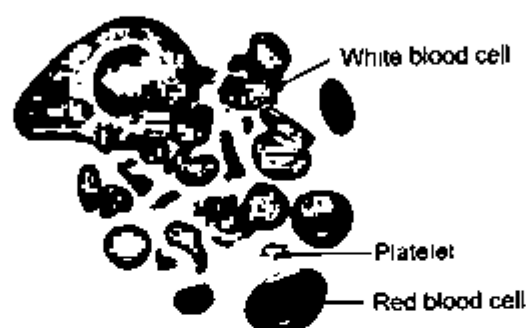
Proteins make 7-9% by weight of plasma. The important proteins present in plasma are:

- Antibodies
- Fibrinogen (blood clotting protein)
- Albumin (maintains the water balance of blood)

**Other Substances:**

Plasma also contains:

- Digested food (absorbed from digestive system)
- Nitrogenous wastes
- Hormones
- Respiratory gases ( $\text{CO}_2$  and  $\text{O}_2$ )



**Figure: Different Cells and Cell-like Bodies in Blood Plasma**

**RED BLOOD CELLS (Erythrocytes)**

**(LHR 2015)**

**Number:**

RBCs are the most numerous of all blood cells.

**In males:**

A cubic millimeter of blood contains 5 to 5.5 million of RBCs in males.

**In females:**

A cubic millimeter of blood contains 4 to 4.5 million of RBCs in females.

**Mature RBCs:**

When RBCs are formed, they have a nucleus. In mammals, when a red blood cell matures, its nucleus is lost. After the loss of nucleus, RBC enters the blood.

**Composition of Cytoplasm:**

About 95% of the cytoplasm of RBCs is filled with haemoglobin which transports oxygen and small amounts of carbon dioxide. The remaining 5% consists of enzymes, salts and other proteins.

**Shape:**

RBCs are biconcave and have an elastic cell membrane.

**Production:**

In embryonic and fetal life, they are formed in liver and spleen. In adults, they are formed in red bone marrow of short and flat bones such as sternum, ribs and vertebrae.

**Life Span:**

Average life span of RBC is about four months (120 days). After which it breaks down in the liver and spleen by phagocytosis.

### **Rate of Destruction of RBCs:**

In a normal person about 2-10 million RBCs are formed destroyed every second.

### **WHITE BLOOD CELLS (Leukocytes)**

(GRW 2014)

#### **Color:**

Leukocytes are colourless because they do not contain pigments.

#### **Migration:**

WBC's are not confined to blood vessels and also migrate out into the tissue fluid.

#### **Number:**

One cubic millimeter of blood contains 7000 to 8000 WBCs.

#### **Life Span:**

Their life span ranges from months to even years, depending on body's needs.

#### **Function:**

WBCs function as main agents in body's defense system.

#### **Types:**

Leukocytes are of two main types:

#### **1. Granulocytes:**

These are the leukocytes with granular cytoplasm.

These include:

- **Neutrophils:**  
Destroy small particles by phagocytosis.
- **Eosinophils:**  
Break inflammatory substances and kill parasites.
- **Basophils:**  
Prevent blood clotting.

#### **2. Agranulocytes:**

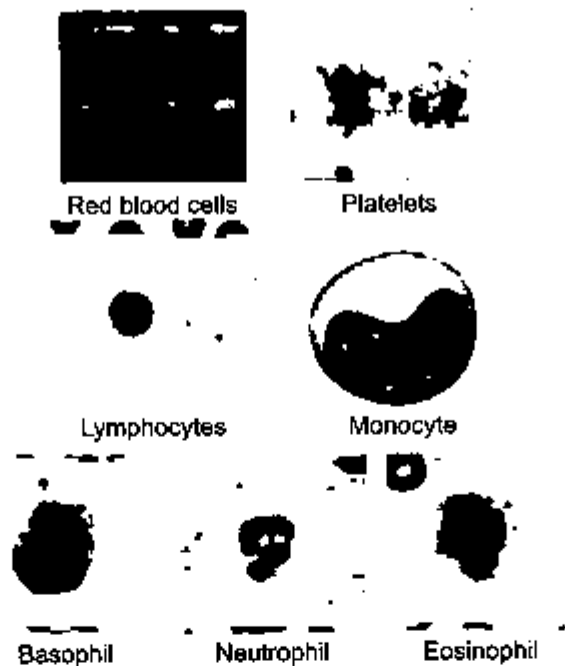
These are the leukocytes with a clear cytoplasm.

These include:

- **Monocytes:**  
Produce macrophages which engulf germs.
- **B and T Lymphocytes:**  
Produce antibodies and kill germs.

#### **Pus Formation:**

WBCs die in the process of killing the germs. These dead cells accumulate and make the white substance called pus seen at the infection site.



**Figure: Blood Cells as seen under Microscope**  
**PLATELETS (Thrombocytes)**

**Introduction:**

They are not cells, but are fragments of large cells of bone marrow called megakaryocytes.

**Nucleus:**

They have no nucleus.

**Pigment:**

They have no pigment.

**Number:**

One cubic millimeter of blood contains 250,000 platelets.

**Life Span:**

The average life span of a blood platelet is about 7 to 8 days.

**Function:**

Platelets help in blood clotting. The clot serves as a temporary seal at the damaged area.

**Dengue Fever:**

In Dengue fever, there is a sharp decrease in number of platelets blood. Because of this, patients bleed from nose, gums and under the skin.

**Q.9 Write a note on blood disorders.**

**Text Book Page # 188**

**(DGK 2014, BWP 2014, SGD 2014, 2015)**

**Ans:**

**BLOOD DISORDERS**

There are many types of blood disorders, including:

- Bleeding disorders
- Leukemia
- Thalassaemia

**LEUKAEMIA (Blood Cancer)**

**Introduction:**

Leukemia is the production of a great number of immature and abnormal white blood cells.

**Cause:**

This is caused by a cancerous mutation (change in gene) in bone marrow or lymph tissue cells.

**Effect:**

The mutation results in an uncontrolled production of defective white blood cells (leukocytes).

**Treatment:**

It is a very serious disorder. The blood needs to be changed regularly with normal blood obtained from donors.

**Cure:**

It can be cured by bone marrow transplant. It is effective in most cases, but very expensive treatment.

### **THALASSAEMIA**

**Meaning:**

It is a Greek word.

- Thalassa means sea
- Haem means blood

**Cooley's Anaemia:**

It is also called Cooley's Anacmia on the name of Thomas B. Cooley, an American physician.

**Cause:**

It is a genetic problem due to mutations in the gene of haemoglobin.

**Effect:**

The mutation results in the production of defective haemoglobin and the patient cannot transport oxygen properly.

**Treatment:**

The blood of the patient is to be replaced regularly with normal blood.

**Cure:**

It can be cured by bone marrow transplant but it does not give 100% cure rate.

**Incidence of Thalassaemia:**

There are about 60-80 million people in the world who carry thalassaemia. India, Pakistan, and Iran are seeing a large increase in thalassaemia patients. Pakistan alone has 250,000 such patients. These patients require blood transfusions for life-time.

**International Thalassaemia Day:**

The world celebrates the International Thalassaemia Day on 8<sup>th</sup> of May. This day is dedicated to raise public awareness about thalassaemia and to highlight the importance of the care for thalassaemia patients.

**Q.10** How blood is classified into groups? Discuss ABO blood group system.

Text Book Page # 189 (LHR 2013, MTN 2014, 2015)

**Ans:** **ABO BLOOD GROUP SYSTEM**

**Classification of Blood:**

Blood group systems are a classification of blood based on the presence or absence of antigens on the surface of red blood cells. An antigen is a molecule that can stimulate an

immune response (antibody production etc.)

### **ABO Blood Group System:**

It is the most important blood group system in humans.

#### **Discovery:**

It was discovered by the Austrian scientist Karl Landsteiner, who found four different blood groups (blood types) in 1900. He was awarded Nobel Prize in Medicine for his work.

#### **Basis:**

In this system, there are four different blood groups which are distinct from each other on the basis of specific antigens (antigen A and B) present on the surface of RBCs.

**1. Blood group A:**

A person having antigen A has blood group A.

**2. Blood group B:**

A person having antigen B has blood group B.

**3. Blood group AB:**

A person having both antigens A and B has blood group AB.

**4. Blood group O:**

A person having none of the antigens A and B has blood group O.

#### **Antibodies:**

After birth, two types of antibodies i.e. anti-A and anti-B antibodies appear in blood serum of individuals.

These antibodies are found according to the absence of corresponding antigen.

#### **Antigen and antibody relation:**

- In persons with blood group A, antigen A is present, so their blood will contain anti-B antibodies.
- In persons with blood group B, antigen B is present, so their blood will contain no antibody.
- In persons with blood group AB, antigens A and B are present, so their blood will contain anti-B antibodies.
- In persons with blood group O, neither antigen A nor antigen B is present. So their blood will contain both antibodies i.e. anti-A and anti-B.

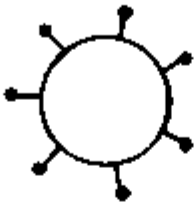
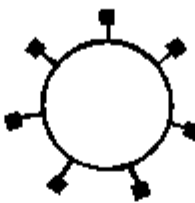
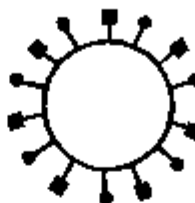
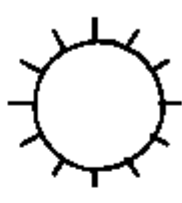
	Blood Group A	Blood Group B	Blood Group AB	Blood Group O
Red Blood Cells				
Antigens on RBCs	Antigen A	Antigen B	Antigen A&B	None
Antibodies in Serum	Anti-B	Anti-A	None	Anti-A & Anti-B

Figure: Presence and Absence of Antigens and Antibodies in ABO Blood Group System

**Q.11** Describe blood transfusion in ABO blood group system. Text Book Page # 190

**Ans:** BLOOD TRANSFUSIONS IN ABO BLOOD GROUP SYSTEM

**Definition:**

The process of transferring blood or blood-based products from one person into the circulatory system of another person is called blood transfusion.

**Advantages:**

Blood transfusions can be life-saving in some situations such as:

- Massive blood loss due to injury
- Blood lost during surgery
- Anaemia
- Haemophilia
- Thalassaemia
- Sickle-cell disease

**Caution:**

A number of infectious diseases (such as AIDS, hepatitis B and hepatitis C etc) can pass from the affected blood donor to recipient. Before blood transfusion, the blood of donor is checked for the presence of germs etc.

**Agglutination:**

The clumping of red blood cells in cases of mismatched blood groups is called agglutination.

**Transfusion:**

Transfusion of blood is done after confirming that no agglutination results in the blood of recipient. If agglutination occurs, the clumped cells cannot pass through capillaries.

**Compatibility:**

For the confirmation of no agglutination, blood samples of donor and recipient are cross-matched for compatibility. Antibodies of recipient's blood may destroy the corresponding antigen-containing RBCs of donor, or antibodies of donor's blood may destroy antigen-containing RBCs of recipient.

**Universal Donors:**

O blood group individuals are called universal donors because they can donate blood to the recipients of every other blood group.

**Universal Recipients:**

AB blood group individuals are called universal recipients because they can receive transfusions from donors of every other blood group.

		Recipient Blood Groups			
		A	B	AB	O
Donor Blood Groups	A	✓	×	✓	×
	B	×	✓	✓	×
	AB	×	×	✓	×
	O	✓	✓	✓	✓

**Blood Transfusion: Cross Matching**

✓ : Can be Transfused

× : Agglutination

**Q.12 Write a note on Rh Blood Group System.**

**Text Book Page # 191**

**Ans:**

**Rh BLOOD GROUP SYSTEM**

**(+ve and -ve Blood Group Systems)**

**Introduction:**

The Rh blood group is also known as positive (+ve) and negative (-ve) blood group system.

**Discovery:**

In 1930's, Karl Landsteiner discovered Rh Blood group system.

**Rh Factors:**

These blood groups are distinct from each other on the basis of antigens called Rh factors.

**Discovery of Rh Factors:**

These factors were first discovered in Rhesus monkey, present on the surface of RBCs.

**Types of Blood groups**

In this system, there are two blood groups:

(i) **Rh-positive Blood Group:**

A person having Rh factors has blood group Rh-positive.

(ii) **Rh-negative Blood Group:**

A person without Rh factors has blood group Rh-negative. Unlike the naturally occurring anti-A and anti-B antibodies of the ABO system, an Rh-negative person does not produce Anti-Rh antibodies unless Rh-factor enters in his/her blood.

**Transfusions of Rh-positive Blood Group:**

Rh-positive blood group can be transfused to Rh-positive recipient because recipient's blood already has Rh-antigens and will not produce Anti-Rh antibody.

**Transfusions of Rh-negative Blood Group:**

Rh-negative blood group can be transfused to Rh-negative because donor's blood does not have Rh-antigen and so the recipient's blood will not produce Anti-Rh antibody.

- If an Rh-negative person receives Rh-positive blood, he/she will produce anti-Rh antibodies against Rh-factors.
- Rh-negative blood can be transfused to an Rh-positive recipient, only if donor's blood (Rh-negative) has never been exposed to Rh-antigens, and does not contain any anti-Rh antibody.

**Q.13 Describe the structure and function of human heart in detail. Text Book Page # 192 (RWP 2015, LHR 2015, 2016)**

**Ans:**

**HUMAN HEART**

**Muscular Organ:**

The heart is a muscular organ responsible for pumping blood through blood vessels by repeated contractions.

**Cardiac Muscles:**

The term 'Cardiac' means 'related to the heart'. The bulk of the walls of heart chambers is made of cardiac muscles.

**Location:**

In human body, the heart is situated between lungs, in the middle of chest cavity (thorax), under breast bone.

**STRUCTURE OF HUMAN HEART**

**Pericardium:**

The heart is enclosed in a sac known as pericardium.

**Pericardial Fluid:**

There is a fluid between the pericardium and heart walls, called pericardial fluid.

**Function:**

It reduces friction between the pericardium and the heart during heart contractions.

**Cardiac Chambers:**

Human heart consists of 4 chambers, like the heart of birds and other mammals.

- Two atria
- Two ventricles

**Atria:**

The upper thin-walled chambers are called left and right atria. The singular of atria is atrium.

**Ventricles:**

The lower thick-walled chambers are called left and right ventricles. The left ventricle is the largest and strongest chamber of the heart.



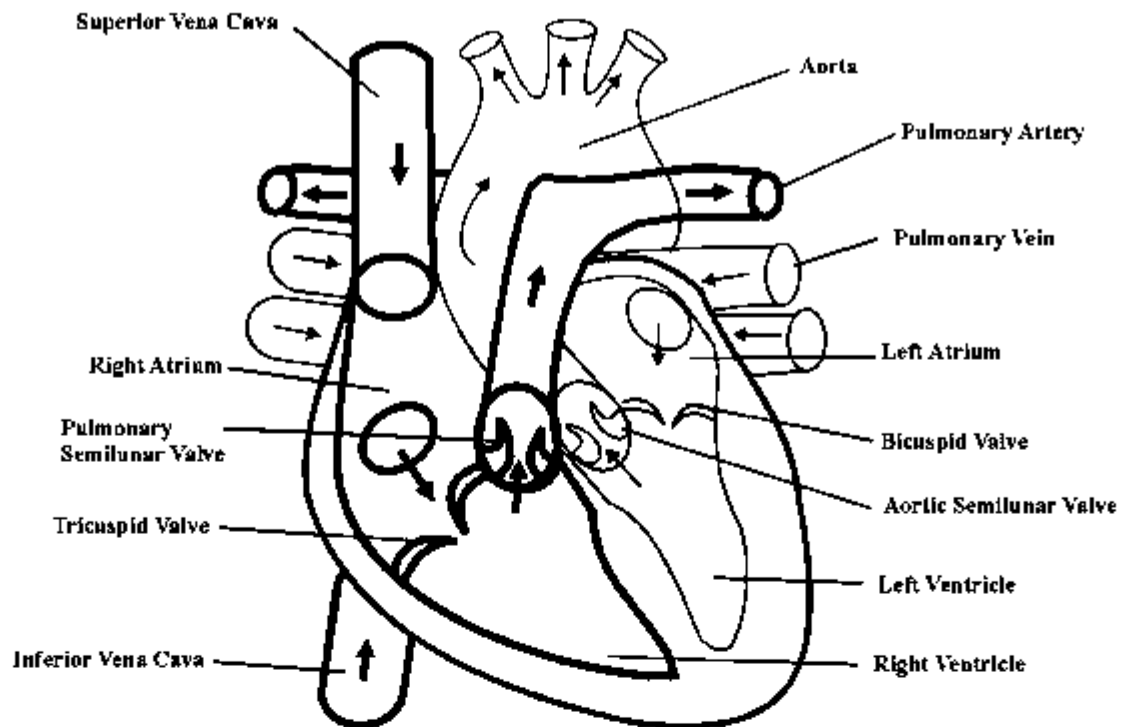


Figure: Human Heart; Structure and Blood Flow

### WORKING OF HUMAN HEART

#### **Double Pump:**

Human heart works as a double-pump. It receives deoxygenated (with less oxygen) blood from body and pumps it to the lungs. At the same time, it receives oxygenated (with more oxygen) blood from lungs and pumps it to all the body.

#### **Separation of Blood:**

Inside heart chambers, the deoxygenated and oxygenated bloods are kept separated.

#### **Blood to Right Atrium:**

The right atrium receives deoxygenated blood from body via the main veins, i.e.: the superior and inferior vena cavae.

#### **Contraction of Right Atrium:**

When the right atrium contracts, it passes the deoxygenated blood to the right ventricle.

#### **Tricuspid Valve:**

The opening between right atrium and right ventricle is guarded by a valve known as tricuspid valve (because it has three flaps). Tricuspid valve prevents the backflow of blood from right ventricle to right atrium.

#### **Contraction of Right Ventricle:**

When right ventricle contracts, the blood is passed to the pulmonary trunk, which carries blood to the lungs.

#### **Pulmonary Semilunar Valve:**

At the base of pulmonary trunk, pulmonary semilunar valve is present.

#### **Function:**

It prevents the backflow of blood from the pulmonary trunk to the right ventricle.

#### **Blood to Left Atrium:**

The oxygenated blood from the lungs is brought by pulmonary veins to left atrium.

#### **Contraction of Left Atrium:**

Left atrium contracts and pumps this blood to left ventricle.

**Bicuspid Valve:**

The opening between left atrium and left ventricle is guarded by a valve known as bicuspid valve (because it has two flaps).

**Contraction of Left Ventricle:**

When left ventricle contracts, it pumps the oxygenated blood in aorta, which carries blood to all parts of body, except lungs.

**Aortic Semilunar Valve:**

At the base of aorta, aortic semilunar valve is present.

**Function:**

It prevents the backflow of blood from aorta to the left ventricle.

**Simultaneous Contraction:**

Both atria are filled simultaneously. They contract together to pump the blood to both the ventricles. Similarly, both ventricles contract simultaneously to pump blood out of the heart.

**Q.14 Write a note on pulmonary and systemic circulation. Text Book Page # 193**

**(BWP 2015)**

**Ans:** Right side of heart collects deoxygenated blood from body and distributes it to lungs while left side collects oxygenated blood from lungs and distributes it to the body.

**PULMONARY CIRCULATION****Definition:**

The pathway on which deoxygenated blood is carried from heart to lungs and in return oxygenated blood is carried from lungs to heart is called pulmonary circulation or circuit.

**Proper Gaseous Exchange:**

The blood in pulmonary circulation is at lower pressure than the blood in systemic circulation. It gives sufficient time to blood for gaseous exchange in lungs.

**SYSTEMIC CIRCULATION****Definition:**

The pathway on which oxygenated blood is carried from heart to body tissues and in return deoxygenated blood is carried from body tissues to heart is called systemic circulation or circuit.

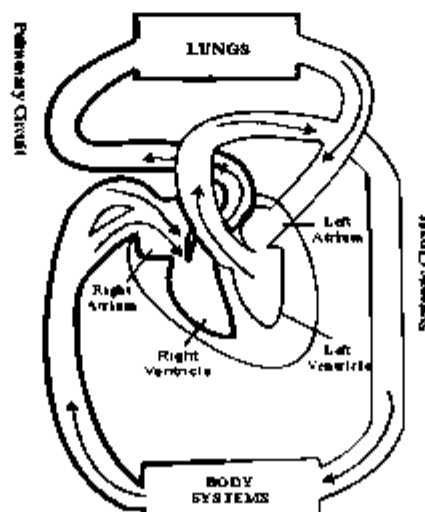


Figure: Double Circuit Circulation of Blood

**Q.15** Write a note on heartbeat.

**Ans:**

### HEARTBEAT

**Definition:**

The relaxation of heart chambers fills them with blood and contraction of chambers propels blood out of them. The alternating contractions and relaxations make up the cardiac cycle and one complete cardiac cycle makes one heartbeat.

**Steps:**

The complete cardiac cycle consists of the following steps:

**(i) Cardiac Diastole:**

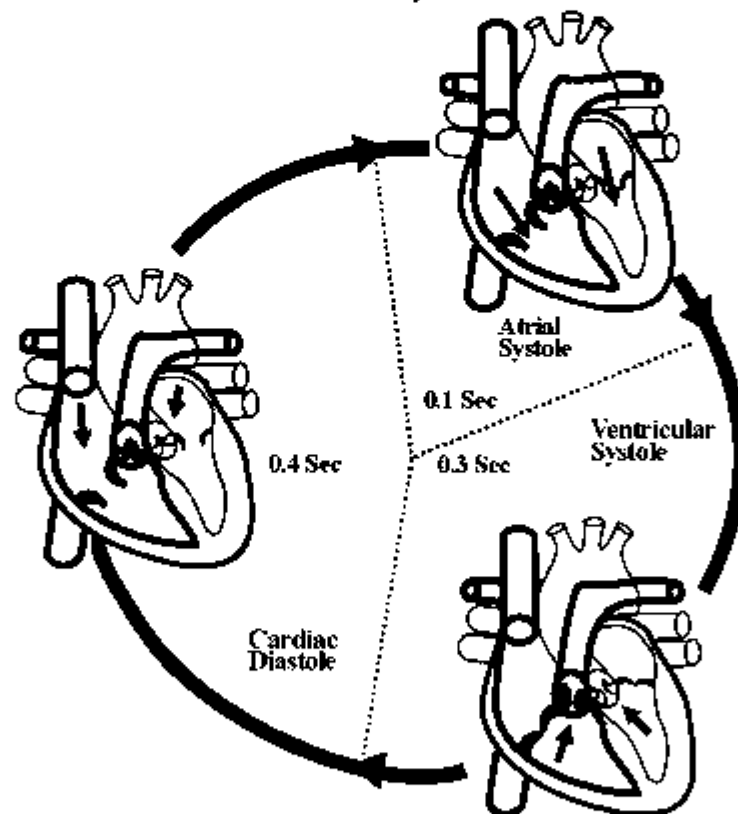
This is the first phase in which the atria and ventricles relax and blood is filled in atria.

**(ii) Atrial Systole:**

Immediately after filling, both atria contract and pump the blood towards ventricles. This period in cardiac cycle is called atrial systole.

**(iii) Ventricular Systole:**

Now, both ventricles contract and pump the blood towards body and lungs. The period of ventricular contraction is called ventricular systole.



**Figure: One Cardiac Cycle**

**Duration of Cardiac Cycle:**

Total duration of one cardiac cycle is about 0.8 second, out of which

- Cardiac Diastole lasts for about 0.4 second
- Atrial Systole lasts for about 0.1 second
- Ventricular Systole lasts for about 0.3 second

**'Lubb-dubb' Sound:**

- When ventricles contract, the tricuspid and bicuspid valves close and produce the sound 'Lubb'
- When ventricles relax, the semilunar valves close and produce the sound 'Dubb'.

**Hearing:**

The 'Lubb-Dubb' sound can be heard with the help of a stethoscope.

**Q.16 Write a note on heart rate and pulse rate.**

**Text Book Page # 195 + 196**

**Ans: HEART RATE**

**Definition:**

The number of times a heart beats per minute is called heart rate.

**Normal Heart Rate:**

At rest or during normal activities, the heart rate is 70 times per minute in men and 75 times per minute in women.

The heart rate fluctuates a lot depending on factors such as:

- Activity level
- Stress level

**Measurement:**

Heart rate can be measured by feeling the pulse.

**PULSE RATE****Definition:**

The rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart is called pulse.

**Feeling of Pulse:**

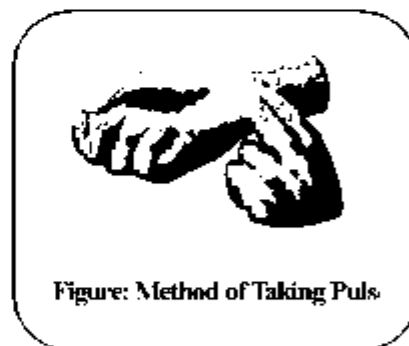
Pulse can be felt in the areas where an artery is close to the skin.

**Examples:**

- Wrist
- Neck
- Groin
- Top of the foot

**Measurement:**

Most commonly, people measure their pulse in their wrist.



**Figure: Method of Taking Puls**

**Q.17 Write a note on blood vessels.**

**Text Book Page # 197**

**BLOOD VESSELS****Introduction:**

The third part of blood circulatory system are the blood vessels.

**Function:**

They transport blood throughout the body.

**Types:**

The most important blood vessels in the system are:

- Arteries
- Veins

- Capillaries

### ARTERIES

(RWP 2014)

**Definition:**

The blood vessels which carry blood away from the heart are called arteries.

**Blood Type:**

In adults, all arteries carry oxygenated blood with the exception of pulmonary arteries that carry deoxygenated blood in them.

**Structure:**

The structure of arteries is well adapted to their function. The walls of an artery are composed of three layers:

- **The Outermost Layer:**  
It is made up of connective tissue.
- **The Middle Layer:**  
It is made up of smooth muscles and elastic tissue.
- **The Innermost Layer:**  
It is made up of endothelial cells.

**Lumen:**

The hollow internal cavity in which blood flows is called lumen.

**Arterioles:**

When arteries enter body organs, they divide into smaller vessels known as arterioles.

**Capillaries:**

Arterioles enter tissues and divide into capillaries.

### CAPILLARIES

**Definition:**

The smallest blood vessels present in the tissues are called capillaries.

**Formation:**

The capillaries are formed by the division of arterioles.

**Structure:**

The walls of the capillaries are composed of only a single layer of cells called endothelium.

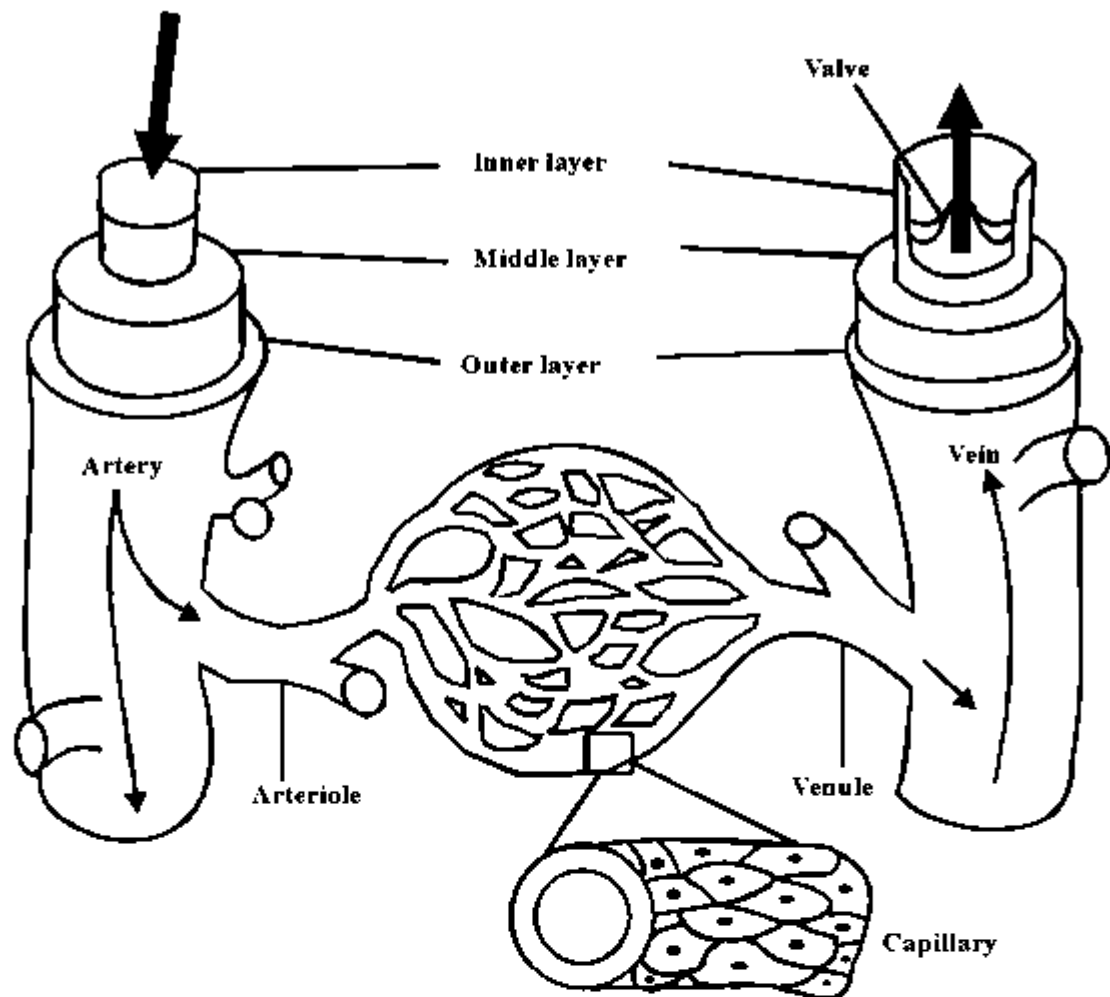
**Function:**

The exchange of materials between blood and tissue fluid is carried out through capillaries.

- The endothelium is so thin that molecules of digested food, oxygen, water etc. can pass through them and enter tissue fluid.
- Waste products such as carbon dioxide and urea can diffuse from the tissue fluid into blood.

**Size:**

Capillaries are so small that the red blood cells need to partially fold into bullet-like shapes in order to pass through them in a single file.

**Figure: Blood Vessels****VEINS****Definition:**

The blood vessels which carry blood towards the heart are called veins.

**Blood Type:**

In adults, all veins carry deoxygenated blood with the exception of pulmonary veins that carry oxygenated blood in them.

**Structure:**

The structure of a vein is also well-adapted to its function. The walls of a vein are composed of three layers as are present in an artery wall.

**Difference from Arteries:**

- The middle layer of the vein has less smooth muscles and elastic tissue compared to arteries.
- The middle layer of vein is comparatively thin.
- The lumen of the veins is broader than that of arteries.
- Most veins have flaps called valves that prevent the back flow of blood.

**Formation of Vein:**

In a tissue, the capillaries join to form small venules. All of the venules of an organ unite to form a vein.

**Q.18 Give a comparison of arteries, capillaries and veins. Text Book Page # 199**

**Ans: COMPARISON OF ARTERIES, CAPILLARIES AND VEINS**

CHARACTERISTIC	ARTERIES	CAPILLARIES	VEINS
Function	Carry blood away from heart	Allow exchange of materials between blood and tissues	Carry blood toward heart
Thickness	Thick	One-cell thick	Thin
Elasticity in walls	Elastic	Non-elastic	less elastic
Muscles in walls	Thick	No muscles	Thin
Blood pressure	High BP	Medium BP	Low BP
Valves	No valves	No valves	Valves present

**Q.19 Write a note on arterial system of man.**

**Text Book Page # 200**

**Ans: THE ARTERIAL SYSTEM**

**Definition:**

The system of arteries which carries blood from the heart to all body parts is called the arterial system.

**Pulmonary Trunk:**

Large pulmonary trunk emerges from right ventricle and divides into right and left pulmonary arteries, which carry de-oxygenated blood to right and left lungs.

**Aorta:**

The oxygenated blood leaving the left ventricle of heart is carried in a large artery, the aorta.

**Aortic Arch:**

The aorta ascends and forms an aortic arch. The arch curves left and descends inferiorly into the body.

From the upper surface of aortic arch, three branches emerge which supply blood to:

- Head
- Shoulders
- Arms

**Dorsal Aorta:**

As the aorta passes down through thorax, it becomes dorsal aorta. It gives off many branches and the important ones are listed here:

**1. Intercostal Arteries:**

Several intercostal arteries supply blood to ribs.

**2. Celiac artery and Superior Mesenteric Artery:**

Supply blood to the digestive tract.

**3. Hepatic Artery:**

Supplies blood to the liver.

**4. Renal Arteries:**

A pair of renal arteries supplies blood to kidneys.

**5. Gonadal Arteries:**

These supply blood to gonads.

**6. Inferior Mesenteric Artery:**

Just below the gonadal arteries, is inferior mesenteric artery supplies blood to a part of large intestine and rectum.

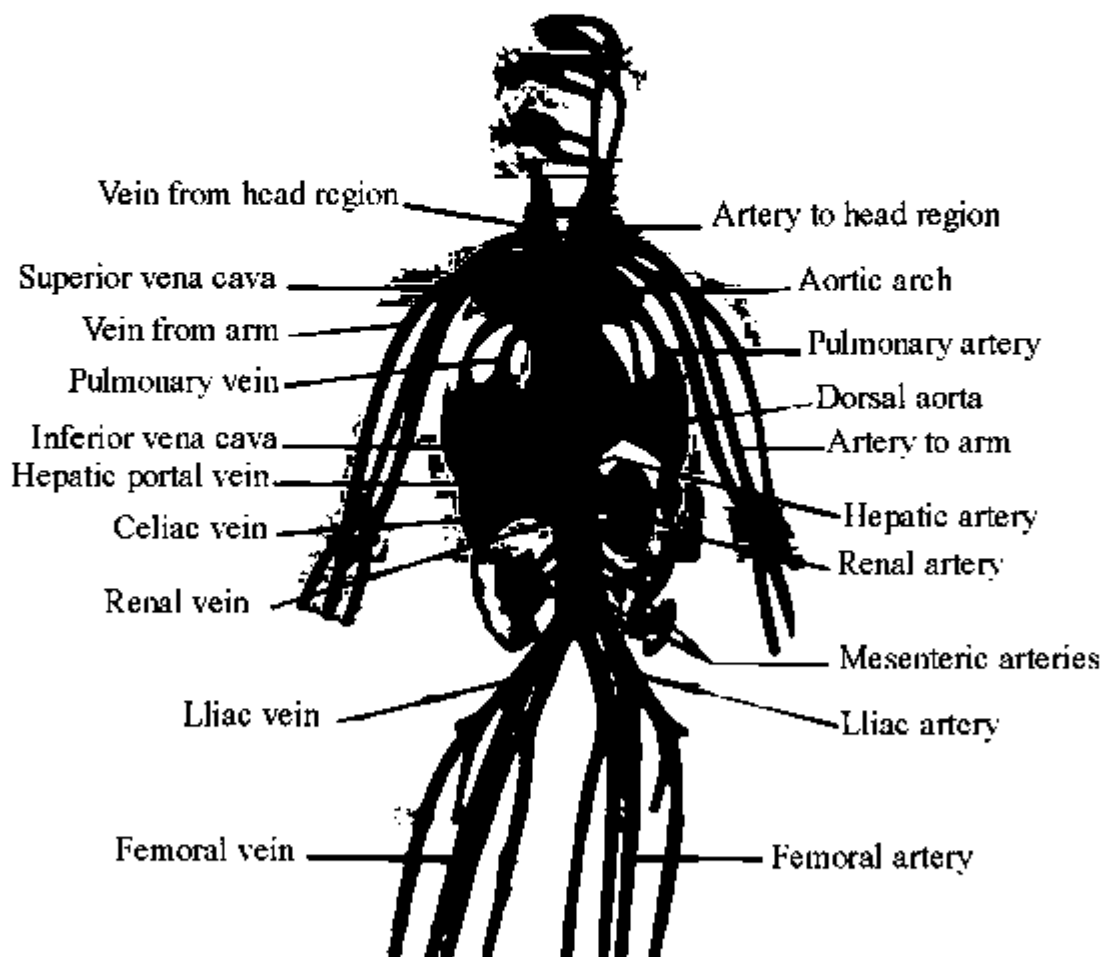
**7. Iliac Arteries:**

The aorta divides into two common iliac arteries, each of which divides into an:

- Internal iliac artery
- External iliac artery

**8. Femoral Artery:**

Each external iliac artery becomes femoral artery in the upper thigh. It gives branches to the thigh, knee, shank, ankle, and foot.



**Figure: Major Arteries and Veins in Human Body**



**Q.20 Write a note on venous system of man.**

**Text Book Page # 202 (DGK 2014)**

**THE VENOUS SYSTEM**

**Definition:**

The system of veins which carries blood from different parts of body to the heart is called venous system.

**Pulmonary Veins:**

Veins from lungs, called pulmonary veins return the oxygenated blood to the left atrium of the heart.

**Major Veins:**

Two major veins carrying deoxygenated blood from rest of the body, empty into the right atrium. These are:

- (i) Superior Vena Cava
- (ii) Inferior Vena Cava

**Formation of Superior Vena Cava:**

Superior vena cava forms when different veins join together from:

- Head
- Shoulders
- Arms

**Formation of Inferior Vena Cava:**

Inferior vena cava is formed by many veins which bring deoxygenated blood from the legs and lower region of body.

The following veins join to form inferior vena cava:

**1. Femoral Vein:**

The veins carrying blood from the following regions of our body join together to form femoral vein:

- Calf
- Foot
- Knee

**2. Common Iliac Vein:**

The femoral vein empties into the external iliac vein, which joins the internal iliac vein, and then both empty into the common iliac vein. The right and left common iliac veins join to form the inferior vena cava.

**3. Hepatic Vein:**

Carries blood from liver and empties into inferior vena cava.

**4. Renal Veins:**

Two renal veins carry blood from kidneys and empty into inferior vena cava.

**5. Gonadal Veins:**

Two gonadal veins carry blood from gonads and empty into inferior vena cava.

**6. Hepatic Portal Vein:**

All veins coming from the following organs drain into hepatic portal vein, which carries this blood to the liver:

- Stomach
- Spleen
- Pancreas
- Intestine

**7. Hepatic Vein:**

Hepatic carries blood from liver and empties into inferior vena cava.

**8. Thoracic Veins:**

In the thoracic cavity, inferior vena cava also receives veins from thoracic walls and ribs.

**Q.21 Write a note on cardiovascular disorders.**

**Text Book Page # 202**

**CARDIOVASCULAR DISORDERS**

**Definition:**

The diseases which involve the heart or blood vessels are collectively called cardiovascular disorders.

- These diseases have similar causes, mechanisms, and treatments.

**Risk Factors:**

The risk factors that lead to cardiovascular disorders include:

- Advanced age
- Diabetes
- High blood concentration of low-density lipids e.g. cholesterol and triglycerides
- High blood pressure (Hypertension)
- Tobacco smoking
- Obesity
- Sedentary life style
- Family history

**Major Cause of Non-accidental Deaths:**

It has been estimated that cardiovascular disorders are the major cause of sudden non-accidental deaths in developed as well as developing countries.

**ATHEROSCLEROSIS**

**Introduction:**

It is a chronic disease. It is commonly referred to as 'narrowing' of the arteries.

**Causes:**

It is characterized by the accumulation of the following in the lumen of the arteries:

- Fatty materials
- Cholesterol
- Fibrin

**Prime Contributor:**

The accumulation of cholesterol is the prime contributor to atherosclerosis.

**Severe Condition:**

When this condition is severe, arteries can no longer expand and contract properly and blood moves through them with difficulty.

**Atherosclerotic Plaques:**

The accumulation of cholesterol results in the formation of multiple deposits called plaques within arteries.

**Thrombus:**

The plaques can form blood clots called thrombus within arteries.

**Embolus:**

If a thrombus dislodges and becomes free-floating, it is called an embolus.

### ARTERIOSCLEROSIS

#### **Introduction:**

Arteriosclerosis is a general term describing any hardening of arteries.

#### **Cause:**

It occurs when calcium is deposited in the walls of arteries. It can happen when atherosclerosis is severe.

### MYOCARDIAL INFARCTION

#### **Meaning:**

The term myocardial infarction is derived from:

- **Myocardium:** The heart muscle
- **Infarction:** Tissue death

#### **Common Name:**

It is more commonly known as heart attack.

#### **Causes:**

It occurs when:

- There is blood clot in coronary arteries
- Blood supply to a part of the heart is interrupted and leads to the death of heart muscles

#### **Medical emergency:**

It is a medical emergency, and a leading cause of death for men and women all over the world.

#### **Silent Myocardial Infarctions:**

Approximately one fourth of all myocardial infarctions are silent i.e., without chest pain or other symptoms. A silent heart attack is more common in the elderly, in patients with diabetes mellitus and after heart transplantation.

#### **Symptoms:**

- Severe chest pain is the most common symptom.
- Sensation of tightness, pressure, or squeezing in chest.
- Pain radiates most often to left arm
- Pain may also radiate to the lower jaw, neck, right arm and back
- Loss of consciousness
- Sudden death may occur

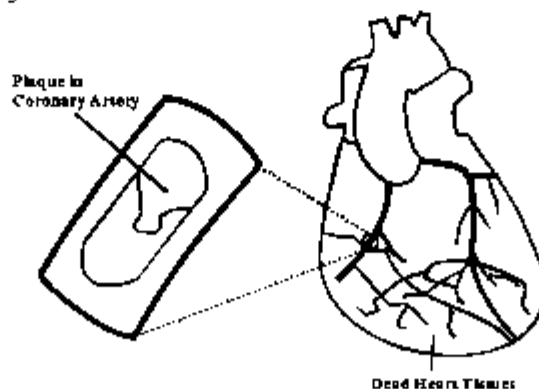


Figure: Atherosclerosis and resulting Myocardial Infarction

#### **Treatment:**

##### **Immediate Treatment:**

Immediate treatment for a suspected acute myocardial infarction includes:

- Oxygen supply
- Aspirin
- Sublingual tablet of glyceryl trinitrate
- Surgical methods (Angioplasty or By-pass Surgery)

#### **Angioplasty:**

The mechanical widening of a narrowed or totally obstructed blood vessel is called angioplasty. Most cases of myocardial infarction are treated by angioplasty.

#### **Bypass Surgery:**

It is a surgery in which arteries or veins from elsewhere in a patient's body are grafted into the coronary arteries to improve blood supply to heart muscles.

#### **World Heart Day:**

World Heart Day is held on 28<sup>th</sup> September every year throughout the world. Its objective is to help people better understand their personal risks of cardiovascular disorders.

### **ANGINA PECTORIS**

#### **Meaning:**

Angina pectoris means chest pain.

#### **Symptoms:**

The pain may occur in heart and often in left arm and shoulder.

#### **Severity:**

It is not as severe as heart attack.

#### **Warning Sign of Heart Attack:**

Angina pectoris is a warning sign that blood supply to heart muscles is not sufficient but shortage is not enough to cause tissue death.

#### **Q.22 What is coronary circulation?**

### **CORONARY CIRCULATION**

#### **Need:**

Even though the heart chambers are continually bathed with blood, this does not nourish heart muscles.

#### **Definition:**

Coronary arteries and veins are collectively called coronary circulation and it is a part of systemic circulation.

#### **Coronary Arteries:**

The blood supply to the heart muscles is provided by coronary arteries which emerge from the base of aorta.

#### **Coronary Veins:**

Heart muscles are drained by coronary veins which empty into right atrium.

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